University of
South-Eastern Norway

H. Ösp Egilsdottir

Using mobile learning to enhance nursing students' competence and confidence in performing basic physical assessment skills

An exploratory sequential mixed methods study

Dissertation for the degree of Ph.D
Person-centred Health Care

Faculty of
Health and Social Sciences

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South-Eastern Norway

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Preface

My interest in physical assessment and clinical reasoning has evolved throughout my nursing career. I clearly remember our physical assessment course in the second year of the four-year nursing education programme in Akureyri (in Iceland) in 1995. We were taught physical assessment under the steady guidance of Dr. Ingvar Teitsson (a medical doctor). At the end of the course, we had to pass a practical exam called the Objective Structured Clinical Examination (OSCE). Fast-forwarding to 2014, I had the opportunity to take a health assessment course in Finland as part of a team at the University of South-Eastern Norway (USN), working to establish and design a new curriculum for nurse practitioners at the university. Participation in that course opened my eyes to the fact that nursing students did not learn physical assessment in their bachelor's programme. In 2015, I therefore took the initiative to start implementing physical assessment in the bachelor's programme in nursing. Since then, I have worked strategically on the implementation process, together with colleagues at the university.

In 2018, the Olav Thon Foundation granted NOK 1.5 million to the research group I was a member of to implement health assessment – particularly physical assessment skills in nursing education – and to integrate human bioscience topics in nursing care. At the same time, the Faculty of Health and Social Sciences at USN developed a strategic plan for strengthening the focus on research in nursing education related to clinical competence. This involved establishing the strategic research area, 'Research in Clinical Competence in Nursing Education (ReCCiNE)', where I was offered a position as a PhD candidate in January 2019. The support from the Olav Thon Foundation was thus essential for designing this Ph.D. project, which continues to focus on physical assessment skills, as well as nursing competence, and students' confidence. The Olav Thon Foundation's support was also the decisive factor for my colleague Kirsten Røland Byermoen to conduct her PhD research, which focusses on a different aspect of physical assessment skills during the final year of the nursing education programme and the transition to becoming a newly graduated nurse in clinical practice.

Acknowledgements

This research has not been a solo project and would not have been possible without the support and involvement of many people who deserve acknowledgment.

First and foremost, I would like to thank the nursing students who chose to participate in the four studies in this dissertation. Their interest and engagement in physical assessment and improving our existing educational practice made this dissertation possible.

I also want to express my gratitude to the Faculty of Nursing and Health Sciences at USN for offering me a position as a PhD candidate in 2019 connected to the strategic ReCCiNE research area, and to the Olav Thon Foundation for the research grant, which greatly contributed to making this project possible.

I have been so fortunate to have great people on my supervising team: Professor Hilde Eide, Professor Anne Moen, Professor Lena Günterberg Heyn, and Associate Professor Espen Andreas Brembo. Your encouragement, guidance, engagement, and support have been crucial to my ability to progress with and finish this dissertation. I always felt that I had one of you to ask for advice when needed.

Dearest Hilde, you have been described as an academic force, which reflects your comprehensive competence, expertise, and considerable experience with research. I feel privileged to have had you as my main supervisor and mentor, beyond this research project. You have always had my best interests in mind, and I am deeply grateful for our talks and discussions, which have constantly stimulated further reflection and growth. Anna, you have been a breath of fresh air on our team and possess comprehensive research competence and experience. I am grateful and honoured to have had you as one of my supervisors and to have had the opportunity to work with you. Lena, your caring and engagement in your PhD candidates' research work is exceptional, and you have always been available for me. I want to thank you for the good conversations we have had during the last four years, both on more personal notes and those more related to the research. Espen, you have so many qualities that make you a good and solid

supervisor. I would especially like to thank you for the extensive and constructive feedback you have always delivered during our collaboration.

Dear Kirsten, we have experienced and achieved many things together concerning implementing physical assessment skills in our nursing education programme. You are a good colleague with whom I have enjoyed working, especially our wonderful discussions and reflections and sharing the ups and downs related to undertaking a PhD.

I have also been fortunate to be part of an enthusiastic community of other PhD candidates. This community has been safe arena for learning from and with peers through discussions, as well as for sharing preliminary work for feedback. I have also highly valued sharing office with you Hilde – thank you for listening to challenges and victories from the PhD work and stories from the real-live. I would also especially like to thank Elin and Anne Mette, who have been my 'PhD sisters' throughout these years – and who have been together with me on the emotional rollercoaster of PhD life.

Conducting this PhD research has also a family project. My dearest children, Isak Örn and Lovisa Òsk, I am impressed by your tolerance and endurance regarding unfinished sentences, a distracted mother, and a half-empty refrigerator – better times are now to come. I am endlessly proud of the people you are becoming and your achievements. Dearest Lars – you have always had my back in so many ways. You have patiently given me time and space to work with the PhD and supported me unconditionally throughout these years. You have been and will continue to be – my safe harbor.

Abstract

Background: Nurses can use physical assessment skills (PAS) to monitor and assess the patient's clinical situation, identify care needs, and detect changes, as well as a possible deterioration. Internationally, PAS are acknowledged as an important part of fundamental nursing care and are based on four examination techniques: inspection, auscultation, palpation, and percussion. PAS has not been taught systematically in nursing education in Norway, but in 2015, PAS was implemented at the University of South-Eastern of Norway. Based on empirical research, 30 skills (of a total of 126) were regarded as central to teach at the bachelor's level. These skills were called 'basic physical assessment skills' (B-PAS). A Progression Model – a novel pedagogical approach for teaching B-PAS – was also developed to support students' learning based on the principles of scaffolding and spaced repetition. In contrast to teaching the skills in a block approach, as is often done internationally, the Progression Model entailed a different approach by teaching B-PAS in each educational year; here, the emphasis is on the importance of nursing students learning to confidently and competently perform B-PAS. In Norway, there is also increased interest in exploring the possibilities for higher education offered by digital technologies, regarding enhancing students' learning and supporting the transfer of knowledge and skills.

Aim: This dissertation is a synthesis of four individual studies and has three overall aims: (a) to explore the role of B-PAS in overall competence in nursing and person-centred fundamental nursing care, (b) to explore how and to what extent a Suite of mLearning Tools may contribute to developing students' competence and confidence in performing B-PAS, and (c) to evaluate the usefulness of the Progression Model for students' confidence in performing B-PAS.

Methods: This dissertation has a complex mixed methods exploratory sequential design, including convergent and emergent components. Quantitative and qualitative research represent an equal status methods that were applied independently or in combination. **Study I** was a mixed methods study, in which 363 nursing students from all three educational years participated. Data were collected via a questionnaire and focus group

interviews, then analysed with descriptive statistics, effect size, and content analysis. Study II was a qualitative study with a longitudinal participatory design approach. Nursing students (*n* = 20) from all 3 educational years participated in the co-design of a Suite of mLearning Tools. The data were collected in eight co-design workshops and analysed with content analysis. Study III was a quantitative pre-/post-test cohort study in which 171 nursing students from the second and third educational years participated. The data were collected with a pre–post questionnaire and analysed with descriptive statistics, effect size, and linear regression. Study IV was a convergent mixed methods study, in which both nursing students and faculty members participated. The data were collected with a questionnaire (*n* = 24), individual interviews (*n* = 3), and a focus group interview (*n* = 3). The data were analysed using descriptive statistics and content analysis. In line with the overall mixed methods design, a qualitative synthesis of all four studies was performed, in which the three overall aims guided the integration processes, and the visualization of the synthesized results were presented in new models.

Results: Novel results show that overall confidence in performing B-PAS is an important part of overall competence in nursing, measured with the Nurse Professional Competence Scale Sort Form (NPC-SF). B-PAS were also shown to be a part of fundamental care; however, contextual factors in the clinical rotation greatly influenced students' performance and use of B-PAS. A Suite of mLearning Tools co-designed with the nursing students was experienced as a useful support in learning B-PAS and using the skills in clinical rotation. The research synthesis underlines that the learning and utilization of B-PAS is a complex learning process for the students, due to the transition between academic and clinical contexts. The Suite of mLearning Tools also supports the transfer of skills and knowledge between learning contexts. The virtual simulation as a facilitated learning activity was experienced by both students and faculty members as a meaningful way to explore the coherence between professional knowledge and the students' own actions, as well as to help students learn to catch clinical cues and develop clinical reasoning skills. The Progression Model seemed to be useful for increasing students' confidence in performing B-PAS.

Discussion: Supporting students in developing confidence and competence during their nursing education is the shared responsibility of key stakeholders in the academic and clinical contexts. This is an important aspect in the learning and use of B-PAS as a systematic approach for patient assessment and to provide fundamental nursing care. By performing B-PAS, nursing students gain a valuable understanding of how these skills can provide the foundation for a good nurse–patient relationship. And increased focus should be on strategies that are suitable for building students' confidence, such as role modelling and constructive feedback, and on how these can be applied in the academic and clinical contexts. The Suite of mLearning Tools can support seamless learning processes between academic and clinical contexts and thus support students' performance of B-PAS.

Conclusion: This dissertation contributes new knowledge about students' development of competence and confidence in performing B-PAS. Systematic patient assessment such as B-PAS is an important aspect of overall competence in nursing and fundamental nursing care. Supporting students in developing competence and confidence in performing B-PAS needs to be is the mutual responsibility of key stakeholders in the academic and clinical contexts. The Progression Model for teaching B-PAS seems to hold promise for building student confidence, together with the Suite of mLearning Tools. Also, utilizing digital technology in higher education as new pedagogical strategies are in line with national guidelines and recommendations and can better meet students' learning preferences.

Keywords: nursing education, mixed methods research, nursing competence, confidence, virtual simulation, physical assessment, nursing students, mobile learning

Abstract in Norwegian (Sammendrag)

Bakgrunn: Systematisk klinisk undersøkelse og vurdering (SKUV) kan gi sykepleiere bedre kompetanse i å vurdere pasientens helsetilstand, identifisere behov for sykepleie og oppdage mulige forverringer. SKUV er anerkjent internasjonalt som en viktig del av helhetlig og grunnleggende sykepleie, og baseres på fire undersøkelsesteknikker: inspeksjon, auskultasjon, palpasjon og perkusjon. I 2015 ble fire fokusområder for SKUV implementert ved sykepleierutdanningen ved vårt universitet som involverte 30 undersøkelsesteknikker ansett for å være sentrale for bachelor nivå i sykepleie. Samlet kalles disse for 'Grunnleggende systematisk klinisk undersøkelse og vurdering' (G-SKUV). Ny pedagogisk grunnlagstenkning basert på å strukturere opplæring av G-SKUV fra det enkle til det mer komplekse og tilrettelegging av repetisjon av G-SKUV over tre år ble utviklet og kalt for Progresjonsmodellen. Ved å ha fokus på G-SKUV i alle utdanningsårene fremheves viktigheten av at sykepleierstudenter lærer å utføre G-SKUV på en kompetent og trygg måte over tid. I Norge har det har også vært økt fokus på mulighetsrommet som følger ved å ta i bruk digital teknologi i høyere utdanning for å styrke studentenes læring og overføring av kunnskap og ferdigheter mellom læringskontekster.

Formål: Denne avhandlingen bygger på fire individuelle studier og har tre overordnede formål: (a) å utforske rollen til G-SKUV knyttet til sykepleiekompetanse og helhetlig og grunnleggende sykepleie, (b) å undersøke hvordan og i hvilken grad kan en digital læringspakke bidrar til studenters selvtillit i å gjennomføre G-SKUV og sykepleiekompetanse, og (c) å evaluere nytten av Progresjonsmodellen for studenters selvtillit i å gjennomføre G-SKUV.

Metoder: Avhandlingen har mixed methods utforskende sekvensielt design med konvergent og emergent komponenter. Kvantitative og kvalitative forskningsmetoder har likeverdig status og ble anvendt uavhengig eller i kombinasjon med hver andre.
Studie I er en mixed methods studie hvor 363 sykepleiestudenter fra alle tre utdanningsårene deltok i studien. Dataene ble samlet med spørreskjema og fokusgruppeintervjuer, og analysert med deskriptiv statistikk, effektstørrelse og innholdsanalyse. **Studie II** er en kvalitativ studie med et longitudinelt deltakende

forskningsdesign (Participatory Design). Sykepleiestudenter (n = 20) fra alle tre utdanningsårene deltok i utformingen av en digital læringspakke. Forskningsdataene ble samlet inn i åtte co-design workshops og analysert med innholdsanalyse. Studie III er en kvantitativ pre-/post-test kohortstudie der 171 sykepleiestudenter fra andre og tredje utdanningsår deltok i studien. Dataene ble samlet inn med spørreskjema og analysert med deskriptiv statistikk, effektstørrelse, korrelasjonsanalyse, faktor analyse og lineær regresjon. Studie IV er en konvergent mixed methods studie hvor både sykepleiestudenter og universitetslektorer deltok i studien. Forskningsdataene ble samlet inn med spørreskjema (n=24), individuelle intervjuer (n=3) og et fokusgruppeintervju (n=3). Deskriptiv statistikk og innholdsanalyse ble brukt for å analysere dataene.
I tråd med utforskende sekvensielt mixed methods designet ble det utført en kvalitativ syntese og integrasjon av hovedresultatene fra de fire studiene med utgangspunkt i hovedhensiktene med avhandlingen. Resultatene fra syntesen er presentert i tabeller og visualiseres i nye modeller.

Hovedresultater: Resultatene viser at selvtillit i gjennomføring av G-SKUV er en viktig del av generell sykepleierkompetanse, målt med Nurse Professional Competence scale Short Form (NPC-SF). G-SKUV ser også ut til å være en del av helhetlig og grunnleggende sykepleie, men at kontekstuelle faktorer i klinisk praksis påvirker i stor grad studentenes gjennomføring og bruken av G-SKUV. Den digitale læringspakken som ble designet sammen med sykepleiestudentene bidro til å støtte læring av G-SKUV og gjennomføringen i klinisk praksis. Syntesen av forskningsresultatene viser at læring og bruken av B-PAS er komplekse prosesser for studentene blant annet på grunn av overgangene mellom de ulike læringskontekstene i sykepleierutdanningen, den akademiske og den kliniske konteksten. Den digitale læringspakken ser ut til å støtte overføring av ferdigheter og kunnskap mellom disse læringskontekstene. Sykepleiestudentene og universitetslektorene opplevede virtuell simuleringen som en meningsfull læringsaktivitet for å utforske sammenhenger mellom ulike fagkunnskaper og egne handlinger, og for å lære å oppdage kliniske tegn, samt å utvikle kliniske vurderingskompetanse. Avhandlingens resultater viste også at Progresjonsmodellen var nyttig for å øke studentenes selvtillit i gjennomføringen av G-SKUV.

Diskusjon: Det å støtte studentenes utvikling av selvtillit og kompetanse under utdanningen er et delt ansvar blant sentrale aktører innenfor akademia og klinisk praksis. Dette er spesielt viktig for læring og bruk av G-SKUV som en systematisk tilnærming til vurdering av pasientsituasjonen og for å gi helhetlig og grunnleggende sykepleie. Ved å bruke G-SKUV får sykepleiestudentene verdifull innsikt i hvordan disse ferdighetene kan danne grunnlaget for utviklingen av sykepleier-pasient relasjonen og bidra til å yte god sykepleie. Resultatene fra avhandlingen viser også at det er behov for å ha økt fokus på veiledningsstrategier som bygger studentenes selvtillit, for eksempel se andre bruke G-SKUV og få konstruktive tilbakemeldinger, og hvordan disse kan anvendes i både akademisk og klinisk kontekst. Ved å utvikle og ta i bruk digitale læringspakker kan det bidra til mer sømløse læringsprosesser mellom ulike læringskontekster og dermed støtte studentenes læring og gjennomføring av G-SKUV.

Konklusjon: Denne avhandlingen bidrar med ny kunnskap om studentenes kompetanseutvikling og selvtillit i gjennomføringen av G-SKUV. Systematisk vurdering av pasientsituasjonen ved å bruke G-SKUV er en viktig del av den generelle sykepleiekompetansen, og helhetlig og grunnleggende sykepleie. Det er et gjensidig ansvar hos nøkkelpersoner i akademia og kliniske praksis til å støtte studentene i å utvikle kompetanse og selvtillit i gjennomføringen av G-SKUV. Progresjonsmodellen sammen med digitale læringspakken virker lovende for å bygge studentenes selvtillit i å gjennomføre G-SKUV. Det å ta i bruk nye pedagogiske tilnærminger som involverer digital teknologi er i tråd med nasjonale retningslinjer og anbefalinger, og kan bidra til at høyere utdanning i større grad møter studentenes læringspreferanser.

Nøkkelord: sykepleierutdanning, mixed methods, sykepleiekompetanse, selvtillit, virtuell simulering, klinisk undersøkelse, sykepleiestudent, mobil læring

List of papers

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Egilsdottir, H.Ö., Byermoen, K.R., Moen, A., & Eide, H. (2019). Revitalizing physical assessment in undergraduate nursing education – what skills are important to learn, and how are these skills applied during clinical rotation? A cohort study. *BMC Nursing*, *18*(41). https://doi.org/10.1186/s12912-019-0364-9

Paper 2

Egilsdottir, H.Ö., Heyn, L.G., Brembo, E.A., Byermoen, K.R., Moen, A., & Eide, H. (2021). Configuration of mobile learning tools to support basic physical assessment in nursing education: Longitudinal participatory design approach. *JMIR Mhealth & Uhealth, 9*(1), e22633. https://doi.org/10.2196/22633

Paper 3

Egilsdottir, H.Ö., Heyn, L.G., Brembo, E.A., Byermoen, K.R., Falk, R.S., Moen, A., & Eide, H. (2023). Factors associated with changes in students' self-reported nursing competence after clinical rotations: A quantitative cohort study. *BMC Medical Education*, *21*(107). https://doi.org/10.1186/s12909-023-04078-7

Paper 4

Egilsdottir, H.Ö., Heyn, L.G., Brembo, E.A., Byermoen, K.R., Moen, A., & Eide, H. (2022). The value of redesigned clinical course during COVID-19 pandemic: An explorative convergent mixed-methods study. *BMC Nursing*, *21*(94). https://doi.org/10.1186/s12912-022-00872-8

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Abbreviations

ABCDE: airways, breathing, circulation, disability and exposure

B-PAS: basic physical assessment skills

CVCS: commercial video conference system

ECTS: European Credit Transfer and Accumulation System

mLearning: mobile learning

NEWS: National Early Warning Score

NLO: national learning outcomes

NPC-SF: Nurse Professional Competence Scale Short Form

NP: nurse practitioner

PAS: physical assessment skills

PD: participatory design

OSCE: Objective Structured Clinical Examination

SETPN: survey of examination techniques performed by nurses

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1 Introduction

In Norway, the healthcare services have undergone major changes as a result of the Coordination Reform launched in 2012 (St.melding.nr.47, 2009). One change was involved moving more advanced health care services from hospitals to the community healthcare setting. More complex treatment follow-up and better coordinated services within and across health care levels, specially concerning the elderly population and others with chronic and complex health conditions. A more recent report from the Norwegian government points at increasingly challenging work environments in the healthcare sector, stating that more competent, confident, and well-trained nurses are needed to manage the complexity of healthcare needs (NOU:4). Higher education largely bears the responsibility of preparing nursing students for clinical practice, which entails that they possess a broad knowledge base, as well as clinical skills and the ability to apply clinical reasoning. Alongside the rapid technological development occurring within the healthcare services, nurses still need to be firmly grounded within fundamental nursing care and to be able to meet patients and patients' families with respect, kindness, empathy, and dignity (Ewertsson et al., 2017; Kitson et al., 2018; Laugesen et al., 2021; Tan et al., 2021) – all of which are core values in person-centred nursing care (Kitson et al., 2018; McCormack et al., 2017).

Competence in nursing encompasses a set of core competences, including knowledge, attitudes, and problem solving, as well as technical, psychomotor, and interpersonal skills (International Council of Nurses, 2010). Nurses' ability to provide holistic care is also an essential part of competence in nursing (Kitson et al., 2013; Valizadeh et al., 2019). Over 160 years ago, Florence Nightingale (1860) highlighted one area of nurse's core competences, stating that, 'if you cannot get the habit of observation one way or another, you had better give up being a nurse, for it is not your calling, however kind and anxious you may be' (p.143). This habit of observation' entails objectively and systematically observing the patient's clinical situation.

Physical assessment represents a contemporary version of 'habits of observation' and is an integrated part of nursing education (Birks et al., 2014; Fennessey & Wittmann-Price,

2011; Lesa & Dixon, 2007). It entails a systematic approach to collecting both subjective and objective patient data (Jarvis, 2019). When collecting objective description of the patient's clinical situation based on human bioscience knowledge, such as anatomy, physiology, pathophysiology, and pharmacology (Breivik & Tymi, 2013; Jensen et al., 2018; Wearn et al., 2013), the nurse also collects subjective data through dialogue and communication with the patient and their family. Using physical assessment grounded in professional knowledge, the patients' care needs are identified so that appropriate nursing care can be initiated; this is essential to providing holistic person-centred fundamental care (Tan et al., 2021). As such, physical assessment is the foundation for nurse's clinical reasoning and needs to be done *competently* and *confidently.* Moreover, as the concepts of competence and confidence are closely intertwined, they must be viewed together (Gottlieb et al., 2021; Smith, 2012; Zieber & Sedgewick, 2018).

Nursing education in Norway is comprised of 180 ECTS, extending over six semesters and equally divided between theoretical courses and clinical rotation (Ministry of Education and Research, 2019). It is regulated by national learning outcomes (NLO), which indicate the expected level of competence in nursing upon completion of the three-year programme of education (Ministry of Education and Research, 2019). Chapter three of the NLO describes the knowledge, skills, and general competence that must be acquired to gain competence regarding health, illness, and nursing care (Ministry of Education and Research, 2019). Comprehensive professional knowledge includes a broad knowledge base about a person's fundamental care needs, human bioscience knowledge, diseases, treatment, and the characteristics of the different phases in life – especially the ageing process (Ministry of Education and Research, 2019). Chapter three in the NLO also clearly states that nursing students must apply professional knowledge about health and diseases to systematically observe, assess, decide, initiate, and document appropriate nursing interventions, evaluate those interventions, and adjust if needed. It is also emphasized that nursing students should be capable of initiating appropriate interventions in a sub-acute or acute clinical situation, carrying out cardiac pulmonary resuscitation with a defibrillator, and mastering relevant medical technical equipment. Finally, within general competence, it is explicitly highlighted that nursing students must

have the capability to organize and perform nursing care for people with acute, critical, and/or chronic illnesses and people with comorbid and complex care needs in community healthcare settings and hospitals (Ministry of Education and Research, 2019).

Giving the above, systematic physical assessment is clearly a critical component of the nursing role, regarding the provision of appropriate person-centred nursing care based on comprehensive professional knowledge and skills. However, newly graduated nurses seem to struggle with evaluating large amounts of patient data when assessing clinical situations, and thus lack necessary skills (Burdeu et al., 2020; Fennessey & Wittmann-Price, 2011; Levett-Jones et al., 2010). This has potential consequences for the quality of nursing care, as poorly assessed clinical situations can lead to missed or delayed care, as well as adverse patient outcomes (Burdeu et al., 2020; Chaboyer et al., 2020; Giddens & Eddy, 2009; Hoffmann et al., 2009; Levett-Jones et al., 2010). Focusing on building nursing students' competence and confidence in performing and using physical assessment during nursing education is therefore imperative, and should start in the first educational year and continued throughout the programme.

The digital transformation in higher education is influencing pedagogical practices and how educational content should be delivered. National reports such as the 'Digitalisation Strategy for the Higher Education Sector 2017-2021' (Ministry of Education and Research, 2017–2021) and 'Strategy for Digital Transformation in the Higher Education Sector' (Ministry of Education and Research, 2021–2025) set out recommendations for future pedagogical approaches in Norwegian higher education, which involve the development and use of mobile technology and digital resources. These guidelines establish norms for how educational content in nursing education should be delivered and the future focus of educational research.

The increased use of mobile technology in higher education offers flexibility in teaching and learning practices, which means that students no longer need to be physically present at the universities to receive educational content and are less constrained by time and place (Barisone et al., 2019). Although the COVID-19 pandemic advanced the development and use of digital learning resources, it remains to be explored how such

technologies affect the quality of higher education (Ministry of Education and Research, 2021–2025). Therefore, it is essential to understand the affordances of digital learning resources in undergraduate nursing education; the role technology has in teaching and learning; and, more explicitly, how to support nursing students in transferring skills and knowledge between academic and clinical learning contexts.

There is a need to investigate and comprehend the variations in nursing students' performance of PAS, encompassing changes in both competence and confidence levels. It is also essential to assess how their overall competence in nursing changes across fundamental care domains. A crucial aspect within the scope of this dissertation thus involves acquiring insights into how students perceive customized pedagogical approaches developed to bolster their confidence in performing PAS during clinical practice.

1.1 The structure of the dissertation

The dissertation contains eight chapters. The first chapter provides the introduction to the overall focus of the dissertation, while chapter two presents empirical, theoretical, and pedagogical perspectives essential to the research project. The third chapter outlines the overall aims of the dissertation, as well as the specific aims and research questions of each of the four studies. Chapter four presents the methodologies and research designs applied in this dissertation: the research methods used in the four studies are detailed in this chapter, along with the data collection and analyses processes, the strengths and limitation of each study, and research ethics considerations. Chapter five presents the summarized results of the four studies, which are then synthesized and integrated according to the overall aim of the dissertation. In chapter six, the integrated results are discussed in light of empirical, theoretical, and pedagogical perspectives. Chapter six also includes a methodological discussion of the mixed methods research design. The final two chapters then present the conclusion of the dissertation, implications of the findings for educational and clinical practice, and suggestions for further research in this field. Following the eight chapters, the dissertation's four papers are presented, along with additional files in the Appendix.

2 Empirical, theoretical, and pedagogical perspectives

In the first part of this chapter, the three main systematic physical assessment approaches in nursing are introduced, with a specific focus on PAS and the pedagogical choices made when implementing PAS in a Norwegian nursing education programme. In the second part, the concepts of competence in nursing, competence development and confidence are presented, along with a theoretical perspective on nursing care. The third part of the chapter focuses on pedagogical strategies for enhancing students' competence and confidence in performing a selection of PAS: This includes an overview of the international educational approach and the pedagogical strategies of scaffolding, spaced repetition, and the Progression Model as a foundation for teaching a selection of PAS in Norway.

2.1 Systematic physical assessment approaches in nursing

The research literature describes three systematic physical assessment approaches used by nurses to collect objective and subjective data about the patient: (a) the National Early Warning Score (NEWS; Considine & Currey, 2014; Royal College of Physicians, 2017), (b) the primary assessment; Airway, Breathing, Circulation, Disability and Exposure (ABCDE; Considine & Currey, 2014; Thim et al., 2012), and (c) the PAS (Considine & Currey, 2014; Jarvis, 2019).

2.1.1 NEWS, ABCDE, and PAS

In Norway, NEWS and ABCDE are taught in nursing education and are widely used in clinical practice. Data collected using NEWS are limited to physiological parameters, such as blood pressure, pulse, respiration rate, oxygen saturation, and body temperature (also called 'vital signs'). In addition, the NEWS includes the assessment of level of consciousness (Royal College of Physicians, 2017). Vital signs are also important components of PAS and provide objective data about a patient's physiological, bodily function (Jarvis, 2019). Deviations from normal ranges may indicate underlying health concerns, such as fever (indicating infection) or elevated blood pressure (suggesting cardiovascular problems). By regularly monitoring vital signs, nurses can promptly

identify physiological changes and intervene appropriately. The ABCDE approach is frequently used to rapidly assess injured, critically ill, or deteriorating patients (Thim et al., 2012). Nurses use of the ABCDE assessment is often dependent on and limited to the specific context in which the nurse works. For example, intensive care nurses actively use the ABCDE assessment in their scope of practice (Johansson, 2021).

The third approach, PAS are well known and widely used within the international nursing profession (Birks et al., 2013; Cicolini et al., 2015; Giddens, 2007; Lesa & Dixon, 2007; Tan et al., 2021). PAS offers a more extensive focus than NEWS or ABCDE and includes history taking (subjective data collection) and performing a physical assessment (objective data collection) based on different organ systems (for example, respiratory assessment or abdominal assessment; Jarvis, 2019). The physical assessment can be used as a comprehensive assessment approach to map many organ systems or as a focused assessment approach to map a specific organ system (Jarvis, 2019). This means that the extent of the physical assessment is tailored to the patient's clinical situation. Performing physical assessment has been described as (a) a complex process involving the application of different skills to map a patient's clinical situation and (b) the process of clinical reasoning that underpins appropriate nursing care (Burdeu et al., 2020; Hoffmann et al., 2009; Levett-Jones et al., 2010). Knowledge about the value of using physical assessment is not well established in Norwegian nursing education (Breivik & Tymi, 2013). Nevertheless, as physical assessment is highly relevant in all clinical practice – in both acute and long-term nursing care – it is imperative that nursing students are taught PAS and the use of the skills are integrated with professional knowledge during their nursing education.

All three physical assessment approaches are based on practical and cognitive components. The practical component involves the hands-on and communication skills that are important elements of establishing the nurse–patient relationship. The cognitive component encompasses the reasoning processes required to fully understand the meaning of the information gathered and the presentation of clinical cues (Jarvis, 2019; Levett-Jones et al., 2010). It is not enough to perform just the 'practical aspect' of the

physical assessment; one must also carefully involve and integrate the 'cognitive aspect'. Therefore, each of the three assessment approaches can be a complex process, in both a practical and a cognitive sense, depending on who is performing them. For example, performing NEWS can be challenging for a first-year nursing student when they must count the patient's respiratory rate or measure their blood pressure (the practical aspect), then assess the outcomes (the cognitive aspect). In comparison, ABCDE and physical assessments can challenge a third-year student and a newly graduated nurse, with regards to the practical and cognitive aspects – both of which involve assessing the objective data collected as a basis for clinical reasoning to initiate appropriate nursing interventions.

2.1.2 Fundamental components of PAS

In the literature, different phrases are used interchangeably to describe the process of using PAS for example, 'physical assessment', 'physical assessment skills', 'physical examination', and 'clinical assessment'. These phrases involve the same components of collecting both objective and subjective patient data. In this dissertation, the term 'physical assessment skills' (i.e., PAS) is used because it explicitly states the physical component and highlights the assessment element, which also implicitly involves decision making regarding the appropriate intervention(s). By this, 'physical assessment' indicates a more processes oriented approach than an 'examination'.

The four examination techniques – inspection, auscultation, palpation, and percussion – are the basis for performing PAS (Jarvis, 2019). Inspection involves using one's vision to look at the body (in a specific way); palpation concerns using the sensibility/sense of touch in one's hands; percussion involves hearing the sounds one makes from tapping one's fingers over specific organs; and auscultation consists of using a stethoscope to listen to different organs (i.e., lungs, heart, and bowels; Jarvis, 2019). Percussion and auscultation techniques have been described as more complex to learn and to perform than inspection and palpation (Birks et al., 2013; Douglas et al., 2015; Giddens, 2007; Kohtz et al., 2017). PAS are organized according to organ systems, where the examination

techniques are used as appropriate within each system and the patient's clinical situation determines the extent of PAS used.

Four key components have been described as the foundation of PAS:

(1) *Psychomotor skills* require hand–eye coordination to carry out the examination techniques, such as percussion, palpation, and the proper placement of the stethoscope (Reese et al., 1979).

(2) *Perceptual skills* comprise listening to and differentiating between normal and abnormal bodily sounds from the auscultation and percussion. It also involves the use of sensibility in one's fingers and hands when palpating and assessing the pulse (Reese et al., 1979).

(3) *Cognitive skills* involve clinical reasoning skills based on the professional nursing knowledge required for analysing assessment findings and differentiating normal from abnormal findings (Reese et al., 1979). This is a complex cognitive process that bundles clinical cues to fully understand the severity of the deterioration, negative changes, or improvement in patient health (Burdeu et al., 2020; Fennessey & Wittmann-Price, 2011; Levett-Jones et al., 2010). Levett-Jones et al. (2010) define clinical reasoning as 'a logic process by which nurses (and other clinicians) collect cues, process the information, come to an understanding of a patient problem or situation, plan, and implement interventions, evaluate outcomes, and reflect on and learn from the process' (p.516); this understanding of clinical reasoning is adhered to in this dissertation.

(4) *Relational and communication* skills have also been highlighted as equally important as the other key components of physical assessment (Fennessey & Wittmann-Price, 2011; Lloyd & Craig, 2007). These skills involve the nurse's ability to establish a relationship with the patient based on trust, respect, empathy, and professional ethics, which are fundamental aspects of person-centred care (Kitson et al., 2013). PAS performed by a nurse are therefore a step towards providing high-quality, person-centred nursing care.

When both nurses and medical doctors use PAS, they contribute their unique perspectives, communicating with a common language and using terminology that can strengthen the overall quality of patient care (Birks et al., 2013; Tan et al., 2021). The four fundamental components of PAS are illustrated in Figure 1.

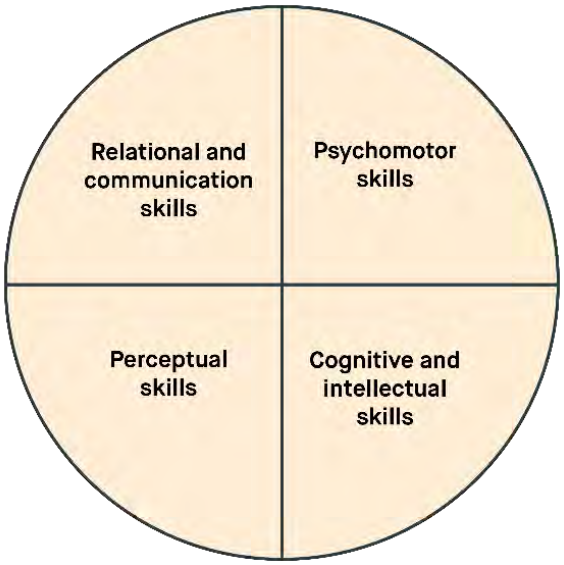


Figure 1. The fundamental components of physical assessment skills.

2.1.3 Revitalization of PAS in nursing education

Research concerning the use of PAS has primarily focused on the discrepancy between which skills are taught in nursing education and which skills nurses use in clinical practice (Birks et al., 2013; Cicolini et al., 2015; Giddens, 2007; Giddens & Eddy, 2009; Kohtz et al., 2017; Secrest et al., 2005; Yamauchi, 2001). In Giddens' (2007) seminal study, results show that, out of 126 PAS taught in nursing education, only 30 were frequently used by nurses in their daily practice. Other researchers have followed Giddens' approach and explored the range of skills that nurses use, and the barriers to using learned skills (Birks et al., 2013; Giddens & Eddy, 2009; Kohtz et al., 2017; Tan et al., 2021). These studies confirm Giddens' (2007) findings, indicating that nurses are not using all the skills they are taught in their nursing education. Douglas et al. (2015) found similar results when surveying nursing students in their final year. The students reported using only 15 skills regularly or frequently in clinical practice and 23 occasionally or rarely; they also reported knowing how to use 53 skills but not using them in clinical practice (Douglas et al., 2015).

Moreover, in Douglas et al.'s (2015) study, students reported regularly using the more 'simple' examination techniques of inspection and palpation when using PAS.

Kohtz et al. (2017) also surveyed nursing students about their use of 126 PAS and found that the students used 21 skills regularly and 9 skills frequently. Further, 8 skills were performed occasionally or rarely, leaving 79 skills that the students were taught in their nursing education but never used in clinical practice (Kohtz et al., 2017). Collectively, the results from these studies (Birks et al., 2014; Douglas et al., 2015; Giddens, 2007; Kohtz et al., 2017; Osborne et al., 2015) point to a considerable inconsistency between the range of skills nurses and nursing students learn in their education programmes and what they actually use in clinical practice. The reasons for this inconsistency and the corresponding consequences have been debated by the cited authors, who suggest that the range of skills being taught should be reduced to what researchers have identified as the core PAS. It has been argued that systematic core PAS should be sufficient to be practicable in clinical practice and thorough enough to identify physiological changes in the patient's condition (Douglas et al., 2016).

These finding stimulated innovative thinking about how and where PAS could fit into the nursing education at our university. It was also decided to take a more in-depth approach by implementing a limited range of skills, instead of teaching all 126 skills. As a result, 4 physical assessment foci (which included 30 skills) were implemented: (a) the respiratory assessment (7 skills), (b) the peripheral circulation assessment and the heart (11 skills), (c) the abdominal assessment (6 skills), and (d) the neurological assessment (6 skills). Most of these skills reflect the core PAS described in the literature. They constitute a basic competence level for performing PAS and are therefore considered suitable for bachelor's-level students. They are accordingly referred to as *basic* physical assessment skills[1] (B-PAS). Figure 2 shows that B-PAS are based on the same fundamental components as PAS, and this understanding of what B-PAS encompass is applied in this dissertation.

[1] Translated to Norwegian: Grunnleggende systematisk klinisk undersøkelse og vurdering (G-SKUV)

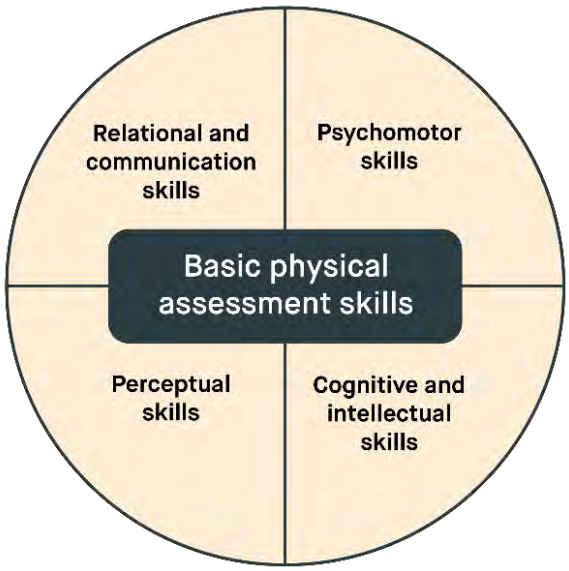


Figure 2. The fundamental components of basic physical assessment skills.

As such, PAS has only been implemented to a limited extent within nursing education in Norway. This also means that B-PAS's role within fundamental nursing care in Norwegian context has yet to be explored.

2.2 Competence, competence development, confidence, and fundamental nursing care

Competence, competence development, confidence and fundamental nursing care are important concepts both in nursing and in relation to B-PAS. In the following, research on competence and competence development is presented, followed by a discussion about confidence. An overview of person-centred fundamental nursing care then concludes this chapter.

2.2.1 Competence and competence development

Various terms have been used to capture and explain the central aspects of competence in nursing, such as 'nurse competence' (Smith, 2012), 'professional competence' (Nilsson et al., 2014), and 'clinical competence' (Pijl-Zieber et al., 2014).

In 2010, the International Council of Nurses defined competence as 'the effective application of a combination of knowledge, skill and judgement demonstrated by an

individual in daily practice or job performance' (International Council of Nurses, 2010, p. 17). They further state that 'competence reflects the following: knowledge, understanding and judgement, various skills – cognitive, technical or psychomotor and interpersonal; and a range of personal attributes and attitudes' (p.17). Moreover, in her concept review, Smith (2012) identified several factors that should be included in a definition of nurse competence and highlighted the integration of knowledge into practice, clinical experience, critical thinking, caring, communication, motivation, and professionalism.

When reviewing the literature in Europe, Kajander-Unkuri et al. (2013) identified eight central aspects of competence as a basis for curriculum development: (a) professional/ethical values and practice, (b) nursing skills and intervention, (c) communication and interpersonal skills, (d) knowledge and cognitive ability, (e) assessment and improving quality in nursing, (f) professional development, (g) leadership, management, and teamwork, and (h) research utilisation. These aspects can be identified in instruments measuring competence in nursing and developed in Scandinavia (Finnbakk et al., 2015; Meretoja et al., 2004; Nilsson et al., 2014).

In this dissertation, the term 'competence' is used more broadly, to include personal attitude, knowledge, caring, communication and technical skills, and problem-solving approaches, in line with Smith (2012) and Valizadeh et al. (2019). Conceptualizing the term in this way aligns with the Norwegian Qualification Framework (Ministry of Education and Research, 2012), as well as the specific learning outcomes for the bachelor's programme in nursing (Ministry of Education and Research, 2019). Competence in nursing is also highly context-dependent (Pijl-Zieber et al., 2014). Different aspects of competence in nursing can be more prominent than others, depending on the context of care. For example, working in the operating room demands that certain aspects of skills and performance are prominent, while working in a nursing home may relies on others (for examples, communication, personal attitude, and aspects of caring). Both contexts are equally important in nursing care. Competence in the performance of B-PAS is thus based on competence within different areas. Figure 2 shows

how the different competence areas are mirrored in the fundamental components of B-PAS, (e.g., professional knowledge, skills performance, personal abilities, problem solving, and caring). This illustrates the complexity of competence in nursing, where no single competence area is more important than another – for example, in the performance of B-PAS.

Assessing students' competence can be used to identify educational and developmental needs during nursing education, as well as for quality assessments of nursing programmes (Finnbakk et al., 2015; Kajander-Unkuri et al., 2014; Nilsson et al., 2018; Pijl-Zieber et al., 2014). Rapidly changing healthcare services and increasing demand for highly competent nurses to provide quality care across care contexts has sparked the questions around how to maintain and/or assess competence in nursing (Kajander-Unkuri et al., 2013; NOU:4). It had been argued that competence can be difficult to assess and measure (Kajander-Unkuri et al., 2013; Pijl-Zieber et al., 2014). Despite this difficulty, the value of assessing and tracking competence has been highlighted, especially the importance of being able to assess whether the level of competence meets the required standards and regulations (Finnbakk et al., 2015; Kajander-Unkuri et al., 2013; Meretoja et al., 2004; Pijl-Zieber et al., 2014).

Competence has largely been measured at a single time point among nursing students at the point of graduation (Forsman et al., 2020; Gradulf et al., 2016; Kajander-Unkuri et al., 2014; Lachmann & Nilsson, 2021; van de Mortel et al., 2021), among newly graduated nurses (Willman et al., 2020), registered nurses (Finnbakk et al., 2015; Halabi et al., 2021; Meretoja et al., 2004), and nurses with specialized education – for instance, within advance practice nursing (Taylor et al., 2021) and intensive care (Leonardsen et al., 2021).

Few studies have measured the development of competence with a longitudinal design. One such study –Taylor et al. (2021) – focused on the longitudinal development of clinical competence among nurse practitioner students. The authors found that the development of clinical competence among the nurse practitioner students was most prominently related to direct clinical practice; however, in relation to other areas of clinical competence (e.g., consulting, coaching, and guidance) the results were

inconclusive (Taylor et al., 2021). Lima et al. (2016) investigated self-assessed competence development among newly graduated nurses commencing a graduate nursing programme, at four different timepoints. Their overall competence increased throughout their first year as a registered nurse. Høegh-Larsen et al. (2022) conducted paired longitudinal analyses of bachelor's students' competence across four time points in the same student cohort – before and after simulation-based education (T1 and T2, at the end of the second year); and the first and last clinical rotation week (T3 and T4, in the third year). The results indicate non-linear changes across the time points and that the transfer of professional competence between learning contexts needs to be better supported (Høegh-Larsen et al., 2022).

Many factors during nursing education have been found to influence students' development of competence. Kajander-Unkuri et al. (2014) found a positive correlation between students' self-reported overall competence and the pedagogical environment in students' clinical rotations. Forty-six per cent of the participating students reported that clinical supervision during their clinical rotation was a highly influential factor in their competence development. The authors conclude that more longitudinal research is needed to assess the development of student's competence during nursing education.

Several self-assessment instruments such as the Nurse Professional Competence Scale – short form (NPC-SF; Nilsson et al., 2018), the Nurse Competence Scale (NCS; Meretoja et al., 2004), and the Professional Nurse Self-Assessment Scale (ProffNurseSAS; Finnbakk et al., 2015), have been developed to capture the different aspects of nursing competence among nursing students and registered nurses. Shared characteristics of these three instruments are that they were developed in Scandinavia and have shown good validity in measuring competence (Finnbakk et al., 2015; Meretoja et al., 2004; Nilsson et al., 2018). The NCS and ProffNurseSAS were primarily developed to measure competence development after graduation; the NPC-SF was developed primarily to assess competence at the point of graduation and shortly after graduation and is based on bachelor's-level competence areas.

Self-assessment is a promising strategy for creating 'competence fingerprints' for each student during their nursing education (Pijl-Zieber et al., 2014). However, self-assessed competence has been criticized for its lack of objective assessment of competence and evaluation bias (Gottlieb et al., 2021; Kajander-Unkuri et al., 2016; Meretoja et al., 2004). An example of this evaluation bias is the 'Dunning-Krueger effect', where novices tend to overestimate their competence while more experienced individuals tend to underestimate their competence (Kruger & Dunning, 1999). Gottlieb et al. (2021) also point out that individuals may show a poor ability to self-assess their own skills, which reflects a possible mismatch between competence and confidence. On the other hand, strengthening self-assessment can stimulate students' reflections about personal and professional assets, as well as their ability to identify areas of improvement (Kajander-Unkuri et al., 2016). Further, the ability to self-assess has been linked to the process of self-directed learning, which is important for life-long learning processes. Pijl-Zieber et al. (2014) argues that the complexity of assessing competence in nursing cannot be narrowed down to objective assessments, as these limit the assessment to 'only' the performance of skills and not the student's personal abilities. The authors also propose multiple methods to assess competence throughout the student's nursing education, including learning plans shared with the instructor, 360° feedback, self-assessment, examinations, peer feedback, direct observation, and learning aids, generating a unique competence fingerprint for each student.

2.2.2 Confidence

'Confidence' is defined by the *Cambridge Online Dictionary* as 'the quality of being certain of your abilities or of having trust in people, plans, or the future' (Cambridge University Press & Assessment). In concept analysis concerning confidence and self-confidence, Perry (2011) identified similar terms used in the literature, such as 'self-confidence', 'confidence', 'self-efficacy', 'self-esteem', and 'self-trust'. The term 'confidence' is often closely associated with self-efficacy, which is a person's belief in their ability to perform a given task (Bandura, 1977). According to Bandura (1977), self-efficacy is a fundamental aspect of human behaviour and plays a vital role in our personal and professional lives;

moreover, the more self-efficacy we have in our ability to perform a certain task (such as B-PAS), the greater the chance for that performance to be successful. In this dissertation, the term 'confidence' is used and defined as 'one's belief in their own ability' aligning with the initial part of the *Cambridge Online Dictionary's* definition and corresponding to the 'task-specific aspects' in Bandura's (1977) explanation of self-efficacy.

Bandura (1977) distinguished between self-efficacy in efficacy expectations and in outcome expectations (Figure 3). These concepts shape the individual's beliefs, actions, and overall motivation. 'Efficacy expectations' refer to the individual's belief in their own capabilities to successfully execute specific actions or behaviours needed to reach the expected outcome. 'Outcome expectations' are the predicted results or consequences of specific actions or behaviours and represent an individual's subjective assessment of the likely outcome of their actions (Bandura, 1977).

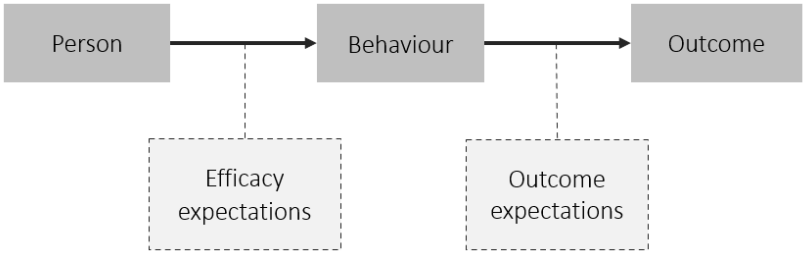


Figure 3. The two aspects of self-efficacy, according to Bandura (1977)

Efficacy expectations and outcome expectations are interrelated concepts; thus, higher self-efficacy beliefs often lead to more positive outcome expectations, as individuals with self-efficacy in their abilities anticipate successful outcomes. Conversely, lower self-efficacy beliefs can result in more negative outcome expectations.

The use of Bandura's (1977) theory to understand confidence in performing B-PAS is illustrated in Figure 4. Efficacy expectations align with students' belief that they can perform examination techniques, whereas outcome expectations reflect students' confidence in performing B-PAS in clinical rotation.

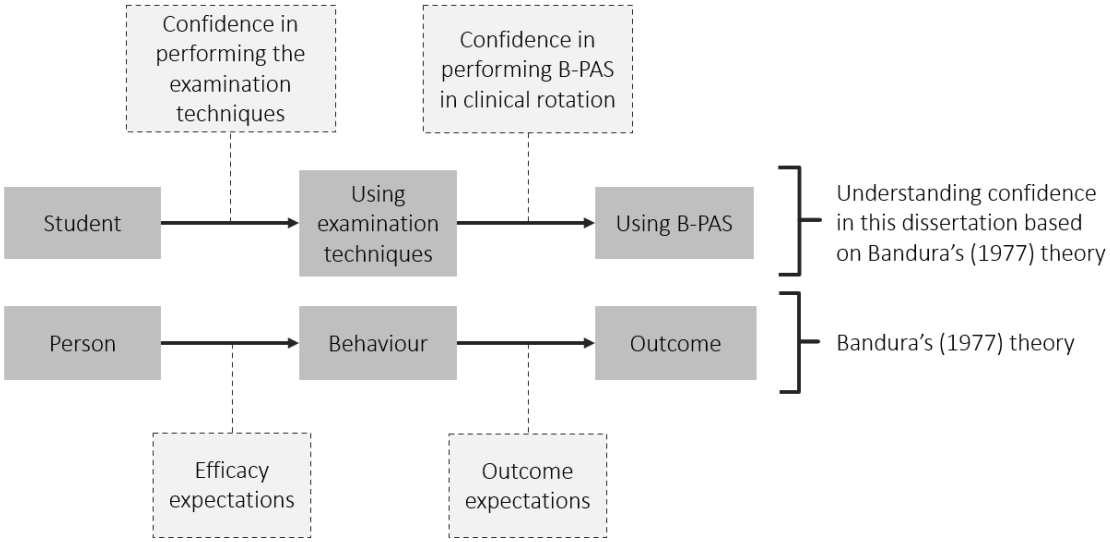


Figure 4. A model of confidence in performing B-PAS, inspired by Bandura (1977).

Bandura (1977) further explains that the development of self-efficacy is based on four main information resources:

(1) *Performance accomplishments* are the most influential information resources, as they are based on personal mastery experiences. When individuals repeatedly experience successful actions, their self-efficacy grows; and, by contrast, repeated failures decrease their self-efficacy.

(2) *Vicarious experiences* occur by observing others succeed through their efforts. Individuals can boost their confidence by witnessing others who are similar to themselves succeeding in challenging situations. Bandura (1977) suggests that exposure to positive role models and seeking social support are crucial for enhancing self-efficacy through vicarious learning. Therefore, by observing role models or mentors, individuals can gain inspiration and develop the belief that they, too, can overcome obstacles and achieve their goals.

(3) *Verbal persuasion* involves convicing a person to believe that they can successfully cope in stressful situations. Bandura (1977) recognizes the power of verbal persuasion in shaping confidence. Encouraging words and supportive feedback from others can significantly impact an individual's belief in their capabilities. When people receive positive reinforcement and constructive feedback, they are more likely to perceive themselves as competent and capable. Bandura (1977) also

emphasizes the importance of surrounding oneself with individuals who provide constructive criticism and support, as this can reinforce and foster confidence.

(4) *Emotional arousal* is connected to individuals' level of anxiety and vulnerability in a stressful situation. Bandura's (1977) suggests that managing and regulating emotions is vital for developing a strong sense of self-efficacy. Negative emotions (e.g., fear, anxiety, and self-doubt) can undermine confidence, whereas positive emotions (e.g., enthusiasm and determination) can enhance it. Bandura (1977) proposes that individuals should practise self-reflection and adopt strategies like relaxation techniques, positive self-talk, and visualization to manage emotional states effectively and cultivate self-efficacy.

These four information resources are highly relevant for developing confidence in performing B-PAS: Repeatedly training with peers can contribute to performance accomplishments, seeing other professionals perform and use B-PAS relates to vicarious experiences, being verbally encouraged to perform B-PAS is connected to verbal persuasion, and experiencing positive emotions when performing B-PAS aligns with emotional arousal.

Empirical studies exploring the use of PAS in clinical practice among nursing students and nurses have identified lack of confidence in performing B-PAS as an important barrier for utilizing the potential of B-PAS in patient care (Douglas et al., 2014; Douglas et al., 2015; Giddens & Eddy, 2009; Kohtz et al., 2017; Lesa & Dixon, 2007). The relationship between confidence and competence has been described as multi-layered, complicated, and intertwined (Gottlieb et al., 2021; Perry, 2011; Smith, 2012; Zieber & Sedgewick, 2018). The issues of over- and under-confidence should be considered when exploring the concepts of confidence and competence. An imbalance in either confidence or competence can negatively affect a nurse's performance in providing nursing care. Overconfidence without sufficient competence may lead to errors or inadequate nursing care, while low confidence despite having adequate competence can hinder a nurse's ability to provide optimal care (Gottlieb et al., 2021).

This relationship between competence and confidence demonstrates that nursing education should emphasize the development of confidence as a pivotal component of developing competence in nursing. Lack of confidence in performing B-PAS can therefore influence the competence development of using these skills. No study has explicitly focused on students' confidence in performing B-PAS or in relation to the concept of competence, nor which pedagogical strategies are important for enhancing confidence or competence related to B-PAS. Additionally, there are no instruments that have been developed for assessing confidence in performing PAS – or, in this context, B-PAS.

Reasonable pedagogical strategies need to reinforce the learning of how to perform B-PAS across all three educational years: preparing nursing students to *confidently* and *competently* master both the practical and cognitive aspects of B-PAS. The pedagogical perspectives are addressed further in chapter 2.3. The light green circle surrounds B-PAS, and its four fundamental components in Figure 5 illustrate how competence and confidence encompass the performance and use of B-PAS.

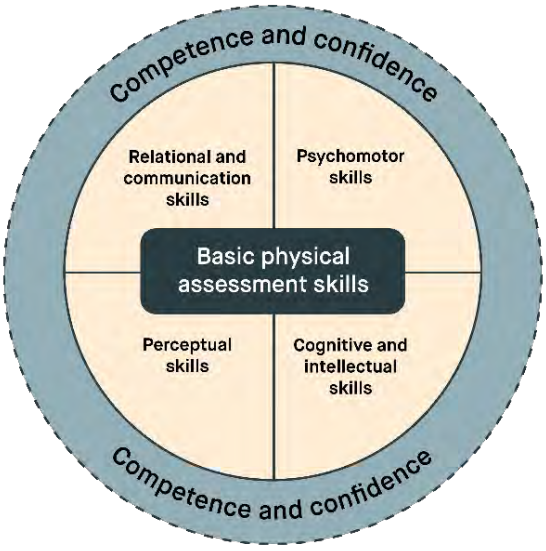


Figure 5. Performance and use of B-PAS influenced by competence and confidence.

2.2.3 Person-centred fundamental care

Helping a person with fundamental care needs is a basic nursing activity in all healthcare contexts; however the complexity of this nursing activity will differ depending on the context of care and the individual patient's needs (Kitson et al., 2018). When people are

in need of healthcare services, whether acute care or more long-term care, mapping and monitoring changes in their clinical situation is a vital part of the nurse's role. Performing and using B-PAS confidently and competently is thus a core activity within nurse's holistic approach to mapping the health situation presented by the patient and their family, laying the foundation for initiating appropriate nursing interventions.

The person-centred Fundamentals of Care (FoC) framework offers a theoretical lens to understand core aspects of nursing in all care contexts, as well as the importance and value of B-PAS. The FoC framework builds on Henderson's 14 nursing activities,[2] grounded in fundamental human needs (Kitson et al., 2018; Kitson et al., 2013). Fundamental care involves actions on the part of the nurse that respect and focus on a person's essential needs to ensure their physical and psychosocial wellbeing. These needs are met through the development of a positive, trusting relationship with the patient and their families/carer (Feo et al., 2017). Every fundamental care need is embedded in an individual's personal, social, and cultural history, which is essential to consider when individual care needs are identified and challenged in various healthcare services (Kitson et al., 2013). The FoC framework (Figure 3) outlines three core dimensions for the delivery of high-quality care: (a) a trusting nurse–patient therapeutic relationship; (b) the integration and meeting of person's physical, psychosocial, and relational needs; and (c) a context of care that supports relationship development and the integration of care.

[2] Henderson's 14 nursing activities in non-prioritized order are as follows: (a) maintaining normal breathing, (b) maintaining adequate eating and drinking, (c) eliminating bodily waste, (d) maintaining desirable posture and position, (e) helping with sleep and rest, (f) dressing and undressing, (g) maintaining body temperature within normal range, (h) keeping the body clean and well groomed, (i) maintaining a safe environment and preventing injury to the patient and others, (j) helping the patient to communicate with others, (k) worshiping according to one's faith, (l) helping the patient to accomplish work tasks, (m) playing or providing forms of recreation, and (n) using resources to provide learning/discovery/healing.

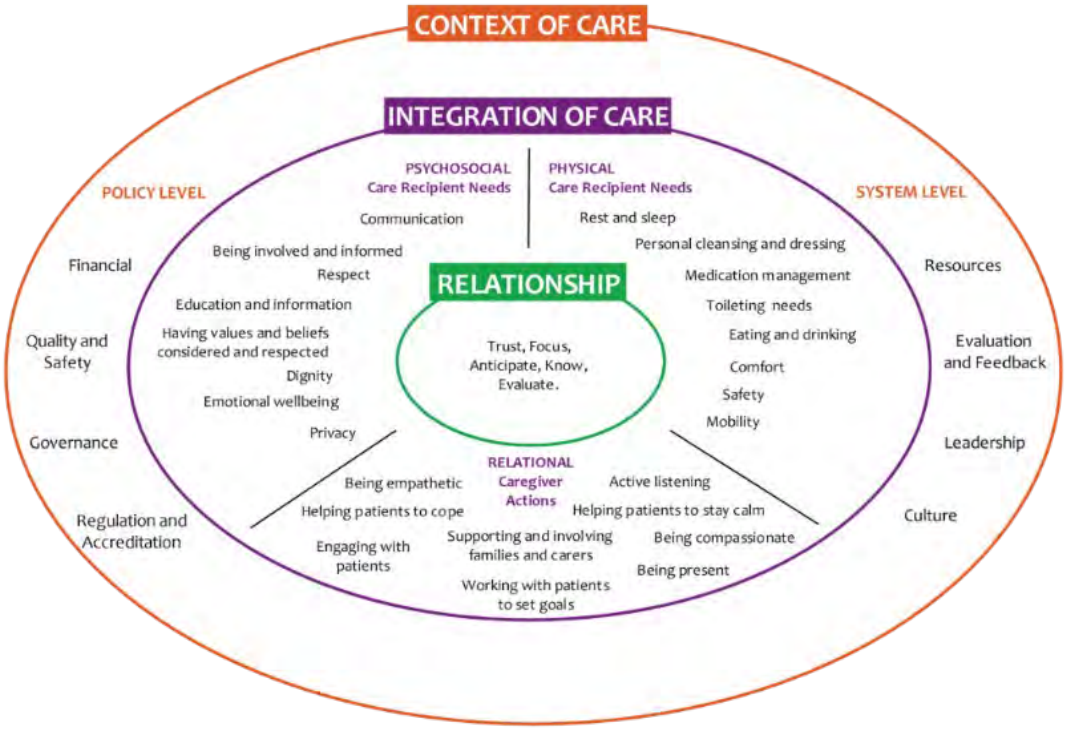


Figure 6. The Fundamentals of Care (FoC) framework[3].

2.2.3.1 Relationship

The core dimension – establishing a therapeutic nurse–patient relationship is a prerequisite for providing person-centred fundamental care and is an ongoing process (Damsgaard et al., 2021; Kitson et al., 2013). Sometimes the patients' family are involved, with the goal of understanding the patient's perspectives and perceived nursing care needs. The relationship between the nurse and the patient is strengthened by dynamic processes based on five key phases initiated by the nurse: (a) establishing *trust*, (b) being *focused* on the patient, (c) *anticipating* the patient's spoken and unspoken care needs, (d) engaging in *knowing* the patient through communication, and (e) *evaluating* the care provided to the patient and/or their family (Damsgaard et al., 2021; Kitson et al., 2013).

[3] Image obtained from https://ilccare.org/the-framework/. Content within image derived from Feo, R., Conroy, T., Jangland, E., Athlin, Å. M., Brovall, M., Parr, J., Blomberg, K., & Kitson, A. (2017). Towards a standardised definition for fundamental care: A modified Delphi study. *Journal of Clinical Nursing*, 2285-2299. https://doi.org/10.1111/jocn.14247

There are no distinct boundaries between these five phases, underlining that they are closely intertwined.

Using a systematic assessment approach such as B-PAS in the process of collecting (both objective and subjective) data is a relevant starting point for establishing trust, facilitating communication, and promoting collaboration between the nurse and the patient. Through a respectful, structured assessment, the nurse can demonstrate their competence, professionalism, and commitment to person-centred care. Using B-PAS can also become meaningful arenas for patient education, allowing individuals to actively participate in their care and fostering a sense of empowerment (Jarvis, 2019).

2.2.3.2 Integration of care

The second dimension involves the processes of the integration of care (Damsgaard et al., 2021; Kitson et al., 2013). A holistic approach aims to identify and understand how physical, psychosocial, and relational care needs are best met in the current situation. For instance, physical needs concern help with personal hygiene, brushing teeth, and breathing adequately; psychosocial needs involve the person's need for autonomy and respect in all phases of the care delivery; and the relational needs entail being met with empathy, dignity, and support from the nurse (Kitson et al., 2018; Kitson et al., 2013). Identifying care needs can be challenging because a person may have multiple care needs. For example, helping a patient to the toilet means that the nurse must focus on meeting the patient's physical, psychosocial, and relational care needs in that specific situation. This example illustrates the complexity of nursing care in what at first glans may be viewed as a 'simple' situation.

One key aspect of the integration of care is the coordination and collaboration among healthcare professionals (Laugesen et al., 2021). B-PAS findings can also be used as the base for effective communication between nurses and other members of the healthcare team. By accurately documenting and communicating B-PAS findings, nurses ensure that important information about a patient's health status – such as vital signs, organ function, and abnormalities – are readily available to other providers (Egilsdottir et al., 2021). This

exchange of information enables a holistic understanding of the patient's clinical situation and helps with the creation of coordinated care plan. Continuously monitoring and assessing the patient's clinical situation by regularly performing B-PAS gives the nurse the opportunity to adjust and tailor their nursing care to the patient's changing care needs.

2.2.3.3 Context of care

The third dimension in the model highlights the contextual factors within the framework. System-level factors involve human and economic resources, care culture, leadership, and evaluation, while policy-level factors involves regulations, financial consideration, quality and safety, and governance (Damsgaard et al., 2021; Kitson et al., 2013). All these factors significantly impact how fundamental care is organized and delivered within in a specific care context. Thus, the contextual factors affect the nurse's work within the FoC framework, the establishment of the nurse–patient relationship, and the successful integration of nursing care.

Nurses in management and leadership roles are key actors in cultivating person-centred care based on caring relationships with patients and their families (Feo & Kitson, 2016). Values and beliefs embedded in the organization towards B-PAS can affect the extent to which these skills are utilized and valued in direct patient care. Further, from a human resources perspective, access to competent nurses and nurse assistants has been shown to impact the quality of care (Avallin et al., 2020; Kitson et al., 2018). In the scope of this dissertation, this also involves whether the available nurses have the necessary competence to perform B-PAS.

Performing B-PAS also contributes to high-quality care by promoting continuity across different healthcare settings and transitions. Patient data derived from B-PAS from one setting can provide a baseline for monitoring and evaluating the patient's health status when they are being transferred. This continuity ensures that relevant information about the patient's physical health and well-being is consistently communicated and considered in the decision-making process (Damsgaard et al., 2021). For example, if a patient is discharged from the hospital with specific physical assessment findings indicating a need

for ongoing monitoring, this information can (and should) be shared with the primary care provider or home healthcare team to ensure continuity of care.

Smith's (2012) description of holistic care correspond with the values in the FoC framework. Holistic care involves establishing patient relationships, respecting cultural differences, and aligning with humanistic principles. It encompasses both technical and organizational competence, such as addressing patient goals, effective communication, anticipating needs, adapting to changes, providing emotional support, staying updated regarding healthcare technologies, advocating patient rights, practicing evidence-based care, and educating patients, families, and novice nurses (Smith, 2012).

In summary, using B-PAS is closely intertwined with the FoC Framework. It ensures that patients' physical needs are assessed, monitored, and addressed while respecting their dignity, involving them in their care, and promoting their overall well-being. B-PAS are a foundational aspect of nursing care that contributes to the holistic and patient-centered approach advocated by the FoC framework. This is illustrated in Figure 7, which shows that B-PAS – with their fundamental components – are influenced by competence and confidence and are situated in person-centred practices.

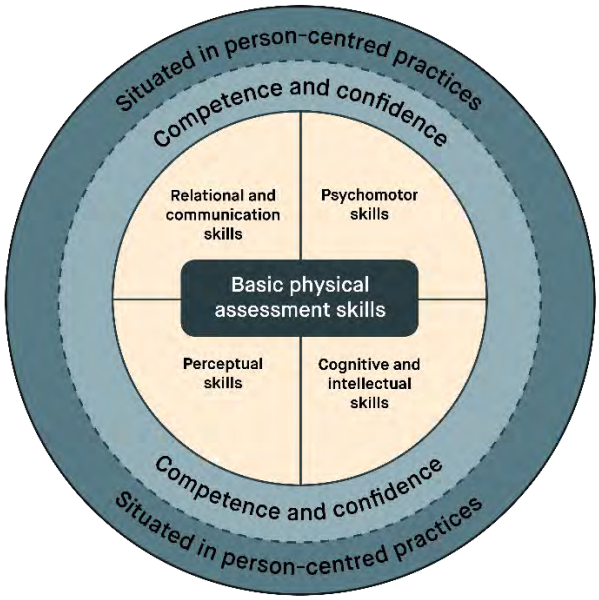


Figure 7. B-PAS are influenced by competence and confidence, and are situated in person-centred practices.

2.3 Pedagogical strategies for B-PAS

This section begins with an overview of the traditional educational practices for teaching PAS internationally. Next, the concepts of scaffolding and spaced repetition – which represent the pedagogical strategies for building competence and confidence in B-PAS – are presented. A Progression Model for teaching B-PAS in a three-year nursing education programme is then presented. Lastly, the role of mobile learning (mLearning) is discussed as additional strategy to support students' learning to perform B-PAS across contexts.

2.3.1 Teaching PAS internationally

Teaching approaches used in medical education have influenced how PAS is taught in nursing education internationally (Birks et al., 2013; Giddens, 2007; Lynaugh & Bates, 1974; Secrest et al., 2005). Fifty years ago, Lynaugh and Bates (1974) suggested that PAS should be taught in nursing education as an individual course with supervised practical training. They argued that students would learn both normal and abnormal bodily findings, which emphasized the importance of human bioscience knowledge in nursing education. This training would then be followed by long-term clinical practise to support continuous professional development for registered nurses (Lynaugh & Bates, 1974). This now seems to be the standard educational approach for teaching PAS in nursing education (Birks et al., 2014; Secrest et al., 2005).

The influence of medical education on how PAS is taught in nursing education has been debated, especially since PAS performed by nurses are fundamentally different from PAS performed by medical doctors (Lesa & Dixon, 2007; Secrest et al., 2005; Yamauchi, 2001). These differences includes (a) the aim and optimal frequency of the PAS; and (b) the use of a follow-up assessment to re-evaluate the patient condition and thus provide appropriate nursing care (Lesa & Dixon, 2007). Lesa and Dixon (2007) emphasize the importance of teaching nursing students a comprehensive range of PAS to better understand the range of skills and areas of focus from which they can select in different clinical situations. Despite being described as an essential content in undergraduate nursing education internationally, practising PAS has been described as challenging due to factors such as lack of role models in clinical practice, lack of confidence, lack of ward

culture, lack of collegial support to use PAS in patient care and role ambiguity (Douglas et al., 2015; Fennessey & Wittmann-Price, 2011; Tan et al., 2021).

Internationally, PAS encompasses over 126 skills taught in nursing education (Giddens, 2006, 2007; Kohtz et al., 2017; Tan et al., 2021). Some researchers argue that this breadth makes it difficult for students to master all the skills confidently and competently. Some of the educational issues highlighted in the literature focus on the fact that students need sufficient time on campus to learn and practise examination techniques and to perform PAS (Birks et al., 2013; Douglas et al., 2015; Hoffmann et al., 2009; Zambas et al., 2016). Therefore, it has been suggested that nursing education should prioritize a limited selection of PAS (Birks et al., 2014; Douglas et al., 2016; Giddens, 2007; Giddens & Eddy, 2009; Kohtz et al., 2017; Tan et al., 2021). Doing so may contribute to a more in-depth understanding and learning of fewer skills rather than a superficial learning of a broader spectrum of skills (Kohtz et al., 2017; Tan et al., 2021). However, there is limited research evidence describing fewer than 126 skills being taught in nursing education (Cicolini et al., 2015; Yamauchi, 2001).

Prior research regarding PAS has mainly focused on the frequency of use among nursing students and nurses, as well as the barriers and facilitators for PAS use in different contexts. However, no studies have investigated alternative pedagogical strategies for teaching PAS, nor explored how students' competence or confidence development is experienced during nursing education. A better understanding of the connection between physical assessment and fundamental nursing care could support nurses' application of PAS in patient care and improve patient experiences and outcomes (Fennessey & Wittmann-Price, 2011; Lesa & Dixon, 2007; Tan et al., 2021).

2.3.2 Scaffolding and spaced repetition

Scaffolding and spaced repetition are considered effective pedagogical strategies for student learning and for reinforcement of acquired knowledge and skills (Dunlovsky et al., 2013; Taber, 2018). Scaffolding is rooted in Vygotsky's learning theory and is a teaching method in which the learning material is structured into smaller units to

enhance learning (Taber, 2018). The principles of scaffolding involve more than just planning a learning activity. When learning a new task (or skill), the novice student relies on support from a more experienced person to perform the specific task. However, over time and as students performs the task more frequently, they become more independent and competent (Taber, 2018). Scaffolding student learning therefore align well with Bandura's (1977) theory of self-efficacy.

McDonald et al. (2018) emphasized the need for more strategic pedagogical thinking (e.g., scaffolding) for learning core nursing skills such as B-PAS. The authors also highlight the importance of considering students' prerequisites and cognitive load in the different educational years when introducing learning material (McDonald et al., 2018). This is highly relevant when implementing, for instance, digital learning resources in educational courses, as the educational content must be tailored to the competence level of the students intended to use the digital resources (McDonald et al., 2018). Following this logic, scaffolding may be an effective pedagogical strategy: The task (i.e., B-PAS) is scaffolded within a specific timeframe, with the goal that students will eventually master it independently. In this way, scaffolding helps to bridge the learning goals of a specific task and the student's capability, which will eventually expand as the learning of the task progresses (Taber, 2018). Wood and Wood (2009) describe the task of the teacher as 'giving more help when the learner gets into difficulty, and offer less help as they gain proficiency' (p. 140).

Spaced repetition is a pedagogical strategy that underlines the advantages of teaching educational content repeatedly and reinforced over time, rather than teaching educational content massively over a short period of time (Dunlovsky et al., 2013; Kang, 2016). This strategy supports the student's learning process, contributes to knowledge and skills retention, and is suitable for both theoretical and practical skills learning (Dunlovsky et al., 2013; Kang, 2016). Importantly, carefully timing the specific learning activity and feedback is also essential for transferring learning and skills between learning contexts (Kang, 2016).

The repetitive training can contribute to students' efficacy expectations and their preparedness for performing B-PAS in clinical rotation are strongly related to developing outcome expectations. Both scaffolding and spaced repetition seems therefore to align well with Bandura's (1977) perspectives on the development of self-efficacy – which, in the context of this dissertation, is related to the development of competence and confidence in performing B-PAS.

2.3.3 The Progression Model

The implementation of B-PAS at our university involved a thorough review of the research literature regarding nurses' use of PAS internationally. This review guided the selection of skills most frequently used by nurses, as elaborated in chapter 2.1.3. Faculty members critically reviewed the curriculum at our university, to identify how and where the teaching of B-PAS could fit in. Through this pedagogical exploration of the curriculum a Progression Model was developed in alignment with learning outcomes in the different courses and based on the principles of scaffolding (Taber, 2018) and spaced repetition (Dunlovsky et al., 2013; Kang, 2016). Additionally, a detailed pedagogical plan was developed for the actual learning activities to reach the intended learning outcomes (see Appendix 1). The Progression Model (Figure 8) and the pedagogical plan (Appendix 1) are fundamental in three of the four studies comprising this dissertation.

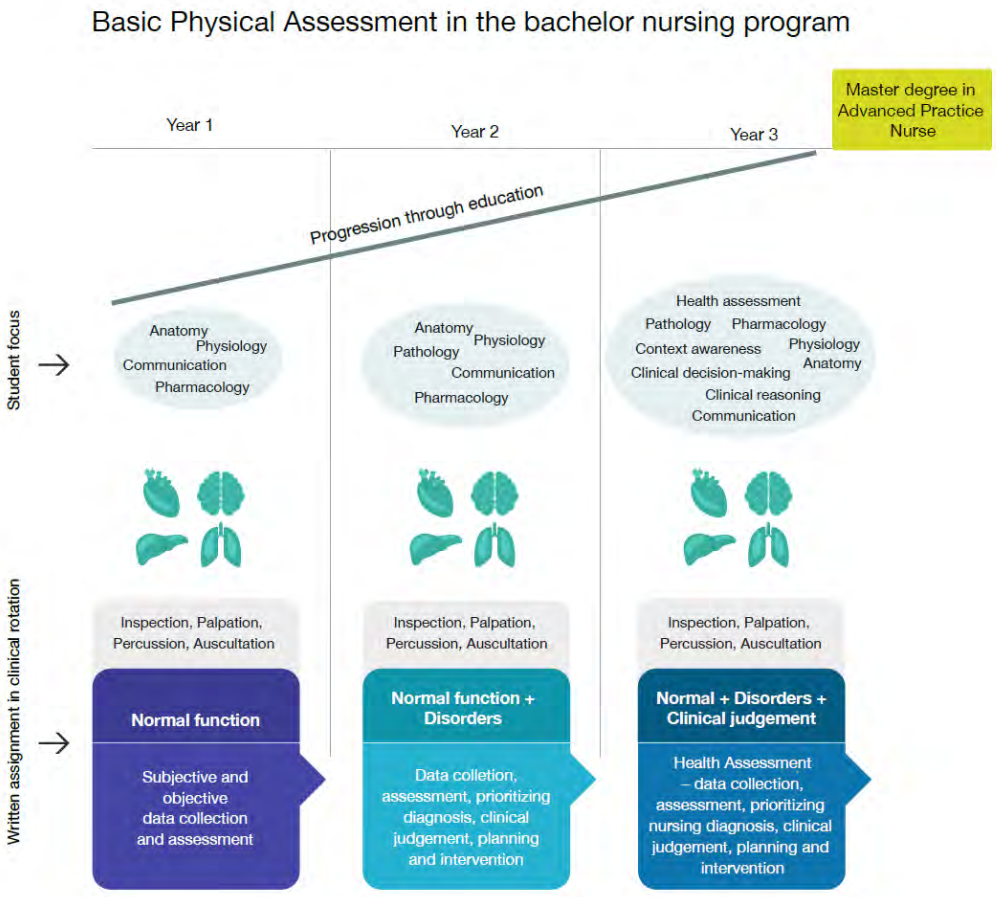


Figure 8. The Progression Model for teaching B-PAS in a three-year nursing education programme.

Since PAS constituted a core competence area within our master's programme in advanced practice nursing, it was important to highlight the difference in competence levels. This included the learning outcomes expected from undergraduate nursing students versus those expected from advanced practice nurse students. The yellow box located in the upper right corner of the model indicates the 'next level' of professional development related to working more independently and towards a more comprehensive range of PAS as a nurse practitioner[4].

In the Progression Model, the examination techniques and B-PAS foci are the same in all educational years. The students practise the examination techniques, inspection,

[4] In the yellow box in the Progression Model, 'Advanced Practice Nurse' can be understood as the same role as nurse practitioner.

palpation, percussion, and auscultation with peers in the skill lab with supervision from faculty members. The focus is on learning to perform physical assessments related to the respiratory system, heart and peripheral circulation system, and abdominal and neurological systems. Although the B-PAS are the same in every educational year, the Progression Model highlights how B-PAS are connected to different aspects of professional knowledge, such as human bioscience topics and fundamental nursing care. As shown in Figure 8, the knowledge component increases in complexity throughout the first, second, and third years, which is expected to be mirrored in the student assignments in the clinical rotations.

As mentioned earlier, a detailed pedagogical plan was developed for teaching and learning B-PAS during the three educational years, aligned with the principles of scaffolding and spaced repetition (See Appendix 1). The foci of the four assessments in the B-PAS are introduced in the first educational year by teaching respiratory assessment, peripheral circulation and heart assessment, and abdominal assessment in the autumn semester and neurological assessment in the spring semester. Hence, the students have time to comprehend and bridge the B-PAS to theoretical knowledge in collaboration with peers and faculty members. In the Progression Model, the principles of scaffolding are noticeable in the different foci between the educational years:

(1) In the first year, the focus is on learning to perform the examination techniques, the systematic approach of B-PAS, and how B-PAS are related to anatomy and physiology, fundamental care, and appropriate nursing interventions.
(2) In the second year, the understanding and performance of B-PAS progresses by connecting the assessment skills and clinical reasoning skills to pathophysiology, pharmacology, fundamental care, and appropriate nursing interventions.
(3) In the third year, building on learning objectives for the previous years, the intension is to reach a comprehensive understanding of the role of B-PAS within cognitive processes (such as clinical reasoning and clinical decision making), as well as to develop situation awareness by utilizing B-PAS.

The repetitive training in and reinforcement of B-PAS throughout the three years reflects the principle of spaced repetition; at the same time, B-PAS are also contextualized and connected to the focus of the different clinical practice periods.

2.3.4 mLearning and B-PAS

The digital transformation in higher education stimulates innovative thinking and the development of new technologies and digital resources for educational purposes. Consequently, new pedagogical thinking and competencies are needed among faculty members in higher education (Korseberg et al., 2022; Ministry of Education and Research, 2017–2021, 2021–2025; Ørnes et al., 2021). The digital transformation is also driving the shift from teacher-centred approaches towards more student-centred practices (Koch, 2014; McGarry et al., 2015). The interplay between the practical and cognitive components of B-PAS are interesting from a pedagogical perspective, but it is also challenging to explore how the digital transformation contributes to the teaching and learning of clinical skills such as B-PAS. Today's students are often referred to as 'digital natives'; they have grown up with mobile devices, such as smartphones or tablets, and most of them are highly skilled in using digital technology – especially when it comes to social interaction and seeking information online (Ministry of Education and Research, 2017–2021; Yot-Domínguez & Marcelo, 2017). Students enrolling in higher education often have expectations regarding the pedagogical strategies they will encounter, such as active learning and peer learning, and that they will (a) be stimulated to use self-regulated learning strategies and (b) to co-design knowledge in a learning community (Gallegos et al., 2019).

In nursing education, students often work closely with peers and faculty members when learning practical and theoretical knowledge in the academic context in preparation for clinical rotation periods. The academic and clinical contexts are both important learning arenas in the education of competent, confident students. Shifting regularly between the academic and the clinical context relies on the student's ability to transfer professional knowledge and clinical skills between these contexts (Ewertsson et al., 2017; McDonald et al., 2018). However, the two contexts do not always harmonize, which also makes the

transfer of knowledge and skills challenging for students. According to Ewertsson et al. (2017), student success in transferring knowledge and skills between academic and clinical contexts relies upon support from faculty members and supervising nurses.

Mobile technology has been shown to be a promising pedagogical strategy aiding students in transferring knowledge and skills between learning contexts (Dunleavy et al., 2019; O'Connor & Andrews, 2015). Chan et al. (2006) describe this as seamless learning; learning at one's convenience with the help of mobile devices, moving between different learning contexts, and connecting and engaging with peers. Research shows that mobile technology and digital learning resources can work well in the teaching of different educational content, such as clinical skills and professional knowledge, especially when combined with other educational strategies (Barisone et al., 2019; Dunleavy et al., 2019; George et al., 2014; McCutcheon et al., 2015; McDonald et al., 2018). With mobile technology, the concept of mLearning has emerged and is defined as 'the use of mobile technology, either alone or in combination with other information and communication technology (ICT), to enable learning anytime and anywhere. Learning can unfold in a variety of ways: people can use mobile devices to access educational resources, connect with others, or create content, both inside and outside classrooms' (United Nations Educational Scientific and Cultural Organisation [UNESCO], 2013, p. 6). mLearning can aid in the tailoring of educational content to individual learning preferences by making the learning material accessible anywhere and anytime, and repeatable as needed (Chang et al., 2018; Martyn et al., 2014; United Nations Educational Scientific and Cultural Organisation [UNESCO], 2013).

mLearning can help students' to feel that they are in charge of their learning, thereby supporting more meaningful and comprehensive learning processes (Barak et al., 2016; Gallegos et al., 2019). Dunleavy et al. (2019) reviewed the literature to evaluate the effectiveness of educational interventions involving mLearning in health professionals' education. They conclude that mLearning is at least as effective or potentially more effective than traditional approaches. By combining mLearning and digital learning

resources, nursing students can be better prepared for flexible and lifelong learning in clinical work environment and digital healthcare services (Martyn et al., 2014).

Different types of digital learning resources are suitable as content for mLearning tools, from podcasts (Vogt et al., 2010) and multimedia presentations to more complicated software involving immersive technology, such as virtual simulation (Koivisto et al., 2016). Another example is a Massive Open Online Course (MOOC). Virtual simulation (also known as e-simulation) has also proven to be a beneficial digital learning resource for various learning outcomes, such as clinical reasoning, articulating professional knowledge, clinical decision making, and practising clinical skills (Bogossian et al., 2015; Koivisto et al., 2016). O'Connor and Andrews (2015) found in their review that most educational content in mLearning tools involved pharmacology, medical dictionaries, and diagnostic manuals to check physiological indicators of diseases and support clinical decision making. The authors also emphasize the need to involve nursing students in the co-design of mLearning tools to be used in higher education (O'Connor & Andrews, 2015). Nursing students have elaborated that using mLearning positively influences their confidence, both in their performance of clinical skills and in their own knowledge (O'Connor & Andrews, 2015, 2018). Stone et al. (2020) reviewed the literature regarding the impact of using video podcasting on students' learning, skill acquisition and confidence and found only four studies that met the inclusion criteria. The content of the video podcasts where related to fundamental clinical skills: indwelling catheter insertion (two studies) and medication administration (two studies). The authors highlight that confidence is often combined with students' satisfaction and therefore the concept of confidence is not clearly understood. Stone et al. (2020) conclude that more research is needed on how mLearning tools' support the learning of clinical skills and increase students' confidence.

Studies reporting on comprehensive mLearning tools (including various digital learning resources aimed at supporting students' learning and performing of PAS or B-PAS) are lacking. Only a few studies utilizing mLearning were found to support some aspects of the learning of clinical skills. Hsu et al. (2019) investigated students' experiences with using a

smartphone-based educational intervention (an application [app]) for conducting respiratory, cardiovascular, abdominal, and neurological assessments. The app mainly consisted of access to clinical scenarios, a practice scenario, and physical examination footage, and the user's track record (Hsu et al., 2019). The results indicate that the app was experienced as an effective, helpful learning resource. O'Connor and Andrews (2016) co-designed an mLearning tool with nursing students, tailored to the students' educational needs, including the provision of support regarding pharmacology, wound care, advanced skills, medical abbreviations, general anatomy, and physiology. It was important for the students that they could easily navigate the mLearning tool interface so they could quickly find the information they needed (O'Connor & Andrews, 2016). The students also wanted to have step-by-step descriptions of how to use the actual clinical skills and additional information about more technical or advanced aspects of the procedures (O'Connor & Andrews, 2016).

Barisone et al. (2019) designed a website as a platform on which students could find four videos and a checklist to support four clinical skills (inserting a urinary catheter, nasogastric tube, and peripheral intravenous line, as well as taking a blood sample). Their results indicate that web-based apps for learning technical–practical skills blended with traditional teaching methods improve students' learning and performance of clinical skills (Barisone et al., 2019).

However, it is important to be aware of challenges in implementing mLearning in nursing education such as tensions in clinical practice around students' use of smartphones, access to Wi-Fi, technical issues related to design functionality and small screens, and students' digital skills (Hsu et al., 2019; O'Connor & Andrews, 2018; Stone et al., 2020).

mLearning and the use of various digital learning resources seems to offer new opportunities for supporting students' learning across learning contexts by giving them more autonomy and independence in their learning processes. However, the role and potential of using mLearning specifically to support students in performing B-PAS and in the confidence development are less explored in the empirical literature.

3 Aims of the study

This dissertation presents a body of research presented as a synthesis of four individual studies with three overall aims:

(a) to explore the role of B-PAS in overall competence in nursing and person-centred fundamental nursing care

(b) to explore how and to what extent a Suite of mLearning Tools could contribute to the development of students' competence and confidence in performing B-PAS

(c) to evaluate the usefulness of the Progression Model for the development of students' confidence in performing B-PAS

The specific aims and research questions in the four published papers are presented in the text below:

Study I presented in paper 1 aimed to evaluate nursing students' self-reported use of B-PAS in clinical rotation after implementation of this component in their nursing education. We also sought to identify factors that inhibit or encourage the nursing students in the use of B-PAS and how these factors can influence the students' development of competence and confidence in applying these skills.

Study II presented in paper 2 focused to co-design a Suite of mLearning Tools with nursing students to support their B-PAS learning and application. The following research questions were:

(1) How do the selected digital learning resources support B-PAS learning, and application in clinical rotation?
(2) Which digital learning resources are beneficial when included in the Suite of mLearning Tools?
(3) How can the selected digital learning resources support the transfer of knowledge from the academic context to clinical settings?

Study III presented in paper 3 explore changes in nursing competence, factors associated with changes after clinical rotation, and the extent to which a Suite of mLearning Tools supports changes in students' assessment skills. The specific research questions were:

(1) How do the students evaluate the Suite of mLearning Tools support use of B-PAS in clinical rotation?
(2) Do the students report changes in confidence in performing B-PAS after one clinical rotation in the second and third educational years?
(3) Do the students report changes in competence after one clinical rotation in the second and third educational years?
(4) Which factors are associated with the changes in overall nursing competence?

Study IV presented in paper 4 explored how a redesigned clinical course supported nursing students in learning fundamental care in their first educational year. Four research questions were formulated:

(1) How much time did the nursing students spend using the available learning activities?
(2) What was the nursing students' self-reported confidence related to the B-PAS in the redesigned clinical course?
(3) What characterized the learning experiences in virtual patient encounters?
(4) Which learning experiences did the nursing students and faculty members perceive as most prominent in the redesigned clinical course?

4 Methods

In this chapter, the mixed methods research design is presented, with an overall view of the different elements of the four individual studies. Next, the research settings, participants, and recruitment strategies are presented, followed by a description of the four studies' data collection, data analysis, strengths, and limitations. In correspondence with the mixed methods research design, the analytical approaches to synthesizing the results from the four studies are then described. Lastly, the research ethics in the dissertation are addressed.

4.1 Mixed methods research design

In this dissertation, mixed methods research was conducted and understood as 'research…that combines elements of qualitative and quantitative research approaches, e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques for the broad purpose of breadth and depth of understanding and corroboration' (Johnson et al., 2007, p. 123). The data collection strategies used were questionnaires, interviews, and longitudinal participatory co-design. The data analysis strategies used were content analysis, descriptive statistics, effect size, correlation analysis, reliability analysis, factor analysis, and regression analysis. Mixed methods research constitutes a means to create different types of knowledge regarding complex topic of interest (Plano Clark, 2019). The use of different designs and methods of collecting data in this dissertation was essential to create different and new knowledge about nursing students' development of competence and confidence in performing B-PAS, as well as promising pedagogical strategies influencing these development processes.

Creswell and Plano Clark (2018) propose three core mixed methods research designs: explanatory sequential design, exploratory sequential design, and convergent design. However, when conducting mixed methods research, the overall research design may not always fit into fixed categories (Schoonenboom & Johnson, 2017). The mixed methods research design in this dissertation classifies as mixed methods research with an

exploratory sequential design, with both convergent and emergent components, drawing from four individual studies (Figure 9). The theoretical assumptions are based on an equal-status design, indicating equality in the contributions in the form of reflections and knowledge creation, driven from both quantitative and qualitative methods. Two studies used a convergent mixed methods design (studies I and IV), one study (study III) combined a cohort pre-/post-test design with a quantitative design, and one study (study II) had a longitudinal qualitative design.

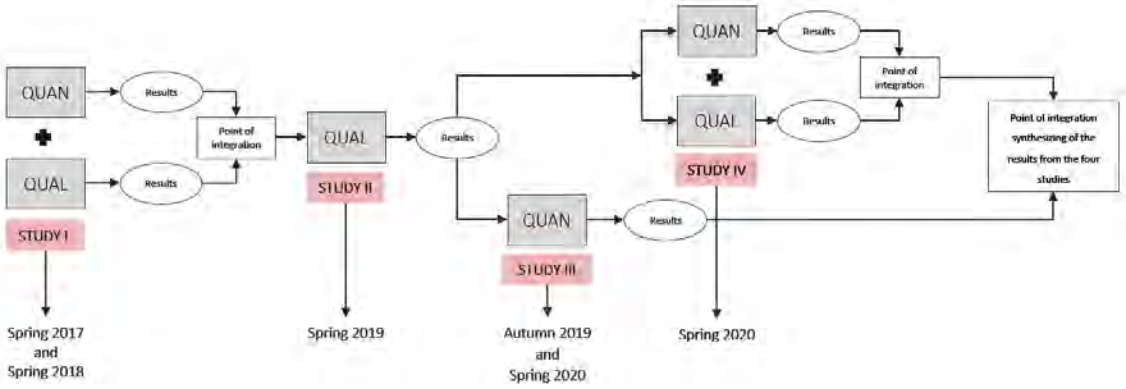


Figure 9. The mixed methods research design with a procedure diagram showing the use of quantitative (QUAN) and qualitative (QUAL) methods.

Schoonenboom and Johnson (2017) point out that mixed methods have several primary characteristics, such as purpose, timing, planned or emergent design, point of integration, and complexity. Therefore, in line with Schoonenboom and Johnson (2017), the research design for this dissertation has been tailored and adjusted to address the overall aims (Table 1).

Table 1. The characteristics of this mixed methods dissertation.

Purpose	When planning the study, a mixed methods design helped clarify the purpose: i.e., to expand and strengthen the body of knowledge (a) regarding educational aspects of pedagogical practices, in order to build students' competence and confidence in performing B-PAS, and (b) in relation to overall competence in nursing as measured with the NPC-SF.
Timing	The research design included convergent and sequential components, indicating that using quantitative (QUAN) and qualitative (QUAL) methods concurrently (studies I and IV) and subsequently (studies II and III; see Figure 9). The exploratory sequential aspects allowed for findings

	in study 1 to inform the focus of study II and provide the basis for study III, highlighting the interdependence and sequence of the different studies.
Planned or emergent design	Studies I–III were carefully planned as sequential, building on each other. Study IV emerged as an additional opportunity due the COVID-19 pandemic and the university lockdown. Study IV represents the emergent component in the mixed methods research design in the dissertation.
Point of integration	There are three points of integration in this mixed methods research design. The points of integration in this dissertation aimed to identify congruence, complementariness, and discrepancy in the different data sets, building on new understandings and knowledge in the studies. The first point of integration, in study I, highlighted (a) the students' need for more support in transferring B-PAS and related knowledge between learning contexts; and (b) that access to digital learning resources be a promising pedagogical strategy. The second point of integration, in study IV, gave insight into student learning and experiences with participating in a new digital learning environment based on using blended learning activity, academic assignment, and digital learning resources for achieving intend learning outcomes. The third point of integration is the qualitative synthesis of the main results from the four studies. Using the strategies of pooling and categorizing the results from the studies constitutes the foundation for discussing the dissertation's main results.
Complexity	The overall research design in this dissertation can viewed as a complex, mixed methods research design, due to the interrelation of the studies, especially I–III, and the multiple points of integration. In addition, the overall mixed methods research design includes explanatory, sequential, and emergent components, underlining the complexity in the dissertation.

In addition, the goal for this dissertation can be classified as reaching 'completeness', where – by applying quantitative and qualitative methods –a comprehensive account of the topic of interest is provided. Table 2 gives an overview of the time frame, design, data collection methods and processes, settings, sample size, and analyses of the four individual studies.

Table 2. The methodological components in the four studies.

	Study I	Study II	Study III	Study IV
Timeframe	Spring 2017 spring 2018	Spring 2019	Autumn 2019 spring 2020	Spring 2020
Design	Mixed methods cohort study	Longitudinal participatory design	Quantitative cohort pre-/post-test design	Convergent mixed methods study
Methods	Mixed methods research design	Qualitative research	Quantitative research	Mixed methods research design
Setting	Academic Clinical rotation	Academic Clinical rotation	Academic Clinical rotation	Academic
Educational year	1st (*n* = 146) 2nd (*n* = 127) 3rd (*n* = 90)	1st (*n* = 6) 2nd (*n* = 6) 3rd (*n* = 8)	2nd (*n* = 72) 3rd (*n* = 99)	1st (*n* = 24)
Participants	Nursing students QUAN sample (*n* = 363) QUAL sample (*n* = 13)	Nursing students QUAL sample (*n* = 20)	Nursing students QUAN sample (*n* = 171)	Nursing students QUAN sample (*n* = 24) QUAL sample (*n* = 2) Faculty members QUAL sample (*n* = 4)
Data collection	Paper-based and online questionnaire Focus group interviews	Co-design workshops based on dialogues	Paper-based questionnaire	Online questionnaire Individual interviews Focus group interviews
Data analysis	Descriptive statistics Effect size Content analysis	Content analysis	Descriptive statistics Factor analysis Correlation analysis Effect size Linear regression analyses	Descriptive statistics Content analysis

4.2 Settings, participants, and recruitment strategies

Given the similarities across the four studies regarding the settings, participants, and recruitment strategies, these aspects are described collectively in the following text.

4.2.1 Settings

The research settings consisted of two contexts: a large multi-campus university (i.e., the academic context) and different clinical rotations at hospitals and in community healthcare settings (the clinical context). The data were collected from spring 2017 to spring 2020 at the university. The data collection in study IV classifies as having been conducted in an academic context, although the data were collected via online questionnaire and through a commercial video communication system (CVCS).

Table 3. An overview of the setting for data collection at the university.

Year of education	Settings at the university	Data collection
First	Skill lab	Study II
	Meeting room	Study I
	CVCS*	Study IV
Second	Skill lab	Studies II and III
	Meeting room	Study I
Third	Skill lab	Studies II and III

*CVCS = a commercial video communication system

The clinical rotations varied, as they took place at hospitals and in community healthcare settings. Table 4 provides an overview of the settings where data were collected during clinical rotations.

Table 4. An overview of the settings for data collection[5] during clinical rotations.

Year of education	Settings in the clinical rotation	Organization in the healthcare system	Data collection
First	Nursing home or home-based nursing care	Community healthcare	Studies I and II
	Digital course		Study IV
Second	Medical ward	Hospital	Studies I, II, and III
	Surgical ward	Hospital	Studies I, II, and III
Third	Home-based nursing care	Community healthcare	Studies I, II, and III

[5] Although the co-design workshops were carried out in the skill lab at the university and are included in Table 3, the participating students were also in clinical rotation at the time of the workshops. The data collection in study 2 is therefore also presented in Table 4 within the different educational years.

4.2.2 Participants and recruitment strategies

A purposive sampling strategy was applied in all four studies: a suitable strategy when recruiting participants with first-hand knowledge about the phenomena of interest (Creswell & Plano Clark, 2018). A total of 593 nursing students from different educational years participated in the 4 studies. Of these, 558 students participated in the QUAN component of the dissertation (reported in studies I, III, and IV) and 35 participated in the QUAL component (reported in studies I, II, and IV). Some of these 35 students are also include in the total number of participants in the QUAN part. In studies I and II, nursing students from all educational years were recruited; in study III, second- and third-year students participated; and only first-year students were recruited to study IV. In addition, given the focus of study IV, a small group of faculty members (*n* = 4) was included. Three different strategies were used:

(a) written information posted in the learning management system at the university (studies I–IV)

(b) verbal information given in lectures (physically and online) and at the skill lab at the university (studies I–IV)

(c) a short video posted on the learning management system, providing information about the study (study IV)

The faculty members were informed verbally and in writing, and purposefully recruited to study IV.

4.3 Data collection, analysis, strengths, and limitations

The research design, data collection, and analyses are presented separately for studies I–IV. The strengths and limitations of each study are also included in each presentation. The dissertation's overall mixed methods design and synthesis will be discussed in chapter 6.4. Please note that more descriptions can be found in the individual papers (1–4).

4.3.1 Study I: Mixed methods cohort study

This mixed methods cohort study used quantitative and qualitative methods to collect data in spring 2017 and spring 2018. A total of 363 nursing students answered the

questionnaire, while 6 first-year students and 7 second-year students participated in 2 focus group interviews.

4.3.1.1 Data collection

The questionnaire used was the ***Survey of Examination Techniques Performed by Nurses – Norwegian with 30 items (SETPN-30).*** The original SETPN with 126 items (Giddens, 2006, 2007; Giddens & Eddy, 2009) was adapted to measure how often the students used the 30 skills included in B-PAS at our university. The original questionnaire is based on the content of two textbooks on physical assessment, an expert panel assessment, and surveys (Giddens, 2007; Giddens & Eddy, 2009; Jarvis, 2019; Wilson & Giddens, 2000).

The scale scores were adapted to relate to the students' clinical rotation periods in contrast to the original score, where the context was 'practice as nurse' and 'part of my clinical practice' (Table 5). The response scale in the SETPN-30 was a 6-point Likert scale, as in the original survey. Paper 1 describes the use of the SETPN-30.

Table 5. The original and modified response options in SETPN-30.

The original SETPN	The modified SETPN-30 in 2017
0 = I do not know how to do this technique	1 = I do not know how to do this technique
1 = I know how to do this technique, but it is not part of my clinical practice	2 = I know how to do this technique, but I have **never done** this in my clinical rotation
2 = I perform this technique rarely (*a few times during my career*)	3 = I perform this technique ***rarely*** in my clinical rotation
3 = I perform this technique occasionally (*a few times during my career*)	4 = I perform this technique ***occasionally*** in my clinical rotation
4 = I perform this technique frequently in my clinical practice (*every 2 to 5 times I work*)	5 = I perform this technique ***frequently*** in my clinical rotation
5 = I perform this technique regularly in my clinical practice (*every time I work*)	6 = I perform this technique **daily** in my clinical rotation

Two additional questions were added to the SETPN-30. One question was intended to obtained students' view on supportive measures: 'Which of the following factors will increase the use of B-PAS in clinical rotation?' Six answers were offered: (a) collaboration with fellow students, (b) more collaboration with the preceptor during clinical rotation, (c) more facilitation from faculty, (d) instruction videos, (e) an online course, or (f) none of the above. The students could mark as many factors as they wished. The second question was related to neurological assessment and was not used and therefore not presented in paper 1.

Two focus group interviews were conducted by the two first authors of paper 1. Six first-year nursing students participated in the first interview (which lasted 45 minutes), while 7 second-year nursing students participated in the second interview (which lasted 55 minutes). In the focus group interviews, the students were encouraged to speak freely about their experiences with using B-PAS in the clinical rotation and about factors hindering or facilitating the use of these skills. After each interview, the two reserachers had a reflective discussion concerning the dialogue in the interview and verbalized initial impressions and thoughts. The interviews were audio recorded and transcribed verbatim.

4.3.1.2 Data analysis

Descriptive statistics were used to analyse the data from the questionnaire to measure central tendency (mean, frequency, and median scores), which allowed comparison with similar studies (Birks et al., 2013; Douglas et al., 2015; Giddens, 2007; Kohtz et al., 2017). In addition, to measure the use of B-PAS and changes in students' development, Cohen's *d* and one-way between-group analysis of variance (ANOVA) of independent groups.

The focus group data were subjected to content analysis (Elo & Kyngäs, 2008). The transcripts were read thoroughly to obtain a comprehensive overview of the content, followed by open coding, grouping codes into subcategories, interpreting the subcategories into generic categories, and then abstracting these into main categories (Elo & Kyngäs, 2008).

4.3.1.3 Strengths and limitations

A main strength of this study is the high response rate from all three cohorts at one university campus, representing diversity in the sample. In addition, the large sample gives a broad overview of the students' use of B-PAS when in clinical rotation in the different educational years. Since this study was exploratory, with no previously established baseline measures for measuring the use of B-PAS or students' change, a power analysis was neither required nor possible. Moreover, due to the early implementation of B-PAS at the time of the study, it was important to explore students' use of B-PAS in clinical rotation. Another strength of the study is that it gives an indication of the usefulness of the Progression Model at an early stage in the implementation of this new model of teaching and learning B-PAS.

One possible limitation of this study is the use of self-reported data. It is important to bear in mind that the participants may have reported what they believed was expected of them or would positively reflect their ability, knowledge, values, and attitudes (Cook & Campbell, 1979). The results may thus reflect this kind of bias. The study also has limited generalizability, since it was conducted at a single campus with no comparison group (i.e., students who did not learn B-PAS).

Another limitation is the modification of the SETPN-30. In the original version, an example of frequency was included in parentheses to ensure the same understanding of the words 'rarely', 'occasionally', 'frequently' and 'daily'. In hindsight, these examples should have been modified in the SETPN-30, because it may have differed as to how each participant understood the meaning of 'rarely', 'occasionally', or 'frequently'. However, using the SETPN-30 (despite the reduction in skills measured and the modification of the items) enabled comparison regarding the frequency of skills used with other studies on physical assessment (Birks et al., 2014; Giddens, 2007; Giddens & Eddy, 2009; Kohtz et al., 2017). Finally, while the SETPN-30 need further development for use in the Norwegian context, having this baseline data from study I may be valuable for future educational research concerning B-PAS in Norway.

4.3.2 Study II: Longitudinal participatory design study

Study II applied a longitudinal participatory design (PD). Based on the results from study I, a total of eight co-design workshops were planned and conducted from February to June 2019, to construct and design a Suite of mLearning Tools suitable to support the learning and use of B-PAS. Figure 10 shows the timeline, content of the workshops, and work undertaken between the workshops.

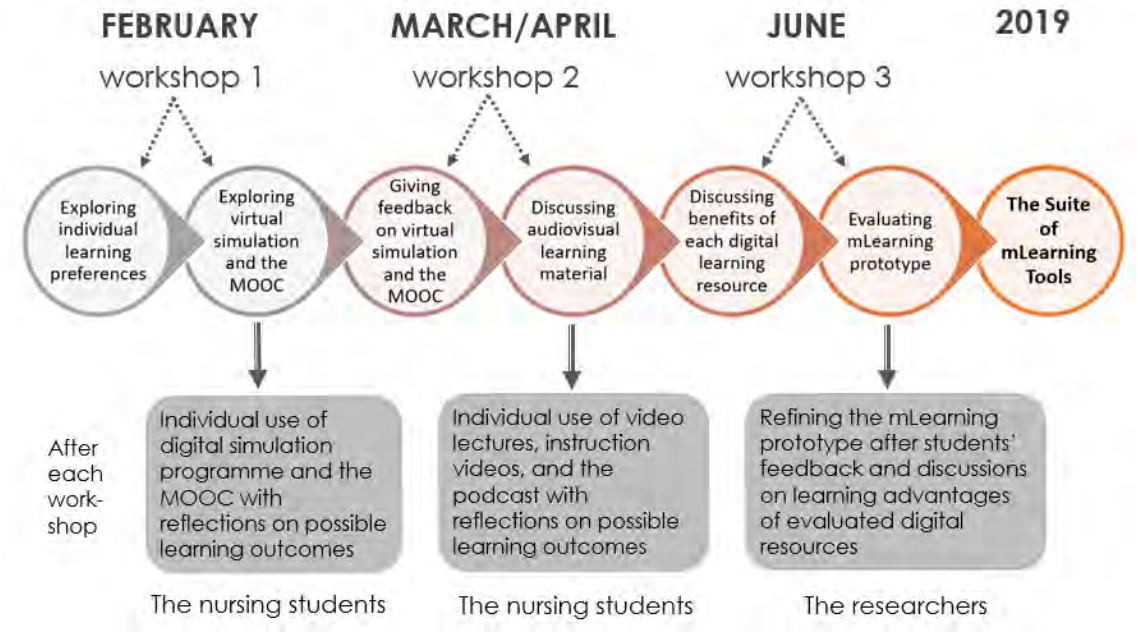


Figure 10. The co-design processes in study II.

PD as a research method enabled the students (the end users) and the researcher (the designers) to discuss and work together to find the best solution for both parts (Bratteteig & Wanger, 2016). The word 'participatory' represents a key element of this method, as the end users' participation was essential in the different processes that were explored in the specific projects (Clemensen et al., 2017). The word 'design' describes the aim of the collaborative processes: to analyse the needed opportunities and the functionality of the product being designed and ultimately created (Clemensen et al., 2017).

The longitudinal design of the workshops was essential in two ways: (a) to tailor the co-design processes so that students could participate; and (b) to give students time to carefully evaluate and test the digital learning resources between the workshops.

In total, 20 students participated in the co-design workshops: 6 first-year students, 6 second-year students, and 8 third-year students. Three workshops were planned: The second- and third- year students participated in all three, while the first-year students were unable to attend the third workshop due to a heavy workload in the final weeks of their clinical rotation. Further descriptions of the digital learning resources can be found in paper 2.

4.3.2.1 Data collection

The co-design processes were organized in 90- to 120-minute workshops. The students were grouped according to their educational years. They had the opportunity to test and evaluate the digital learning resources shown in Figure 10. The students' experiences with the learning resources were the focus of the discussions in the workshops. Two researchers were present in each workshop: One led and facilitated the discussions, while the other participated in the discussions and took notes. After each workshop, the two researchers had reflective conversations about the students' interactions, the dialogue's content and focus, the structure of the workshop, and the facilitation process. These reflections also impacted the planning of the subsequent workshops. Paper 3 details which researcher participated in which workshop.

All the workshops were audio recorded. The audio files from workshops one and two were transcribed verbatim. The audio files from the third workshops were listened to, and notes were taken on interesting and important comments and students' thoughts regarding the pilot version of the Suite of mLearning Tools.

4.3.2.2 Data analysis

The data were analysed using content analysis (Elo & Kyngäs, 2008). The process of the content analysis included open coding, grouping codes into subcategories, and interpreting the subcategories into generic categories, which were than abstracted into main categories (Elo & Kyngäs, 2008). The first step of the analysis process involved an inductive analytical approach, in which the transcribed text material was read and the audio files were listened to, to obtain a comprehensive overview of the data and to

understand the data material as a whole. Thereafter, the analytical approach became more deductive and structured around the digital learning resources under discussion. The first and second author of paper 2 worked independently with the transcripts from all the workshops, before working together to finalize the data analysis. These results were then discussed and refined with the rest of the research group. Figure 11 provides an example of how the digital learning resources were deductively and creatively mapped.

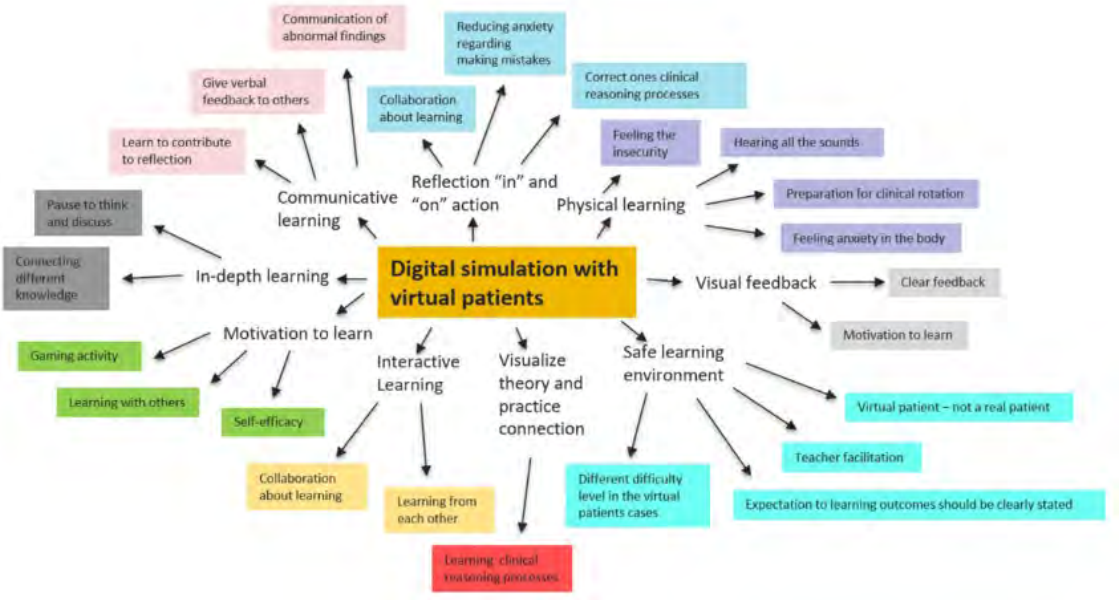


Figure 11. An example of the data analysis in study II[6].

4.3.2.3 Strengths and limitations

A strength of using longitudinal PD is the use of iterative co-design workshops to collaborate with students to better understand what works, for whom, and in which context. The longitudinal design was essential for the continuity of the students' evaluation and testing of the digital learning resources, preceding the construction of the Suite of mLearning Tools. It is also considered a strength that the different members of the research team were involved in the co-design workshops to clarify the understanding

[6] Note that in Figure 11 the term 'digital simulation' is used; however, after discussion in the research group at the Centre for Health and Technology at USN from 2020 to 2021, a consensus for refinement was reach: It was decided that this kind of simulation would be called 'virtual simulation' instead of 'digital simulation'.

of the discussion and how the facilitation could be tailored to the different student groups.

The most important strength is that the content of the Suite of mLearning Tools is based on nursing students' preferences and experiences (as end users), not the perspectives of the faculty members or the nurses who supervised the students in clinical practice. This, however, may also be interpreted as a limitation, since their perspectives on the Suite's usefulness are not covered in this study.

A limitation of study II concerns the representativity of the participating students. The students belong to one campus and may not represent the diversity of the university student population, but rather the most motivated students who had the opportunity to participate in extracurricular activities. Group composition is essential when conducting focus group interviews and co-design workshops. Issues such as homogeneity, heterogeneity, shared experiences, and whether or not the participants know each other can affect the interaction in the group (Krueger & Casey, 2014). The different student groups were homogenous (i.e., the students belonged to the same student cohort, at the same campus). However, the student groups represented both genders and diversity in age and learning preferences. In some of the workshops, it was challenging when one or more participants dominated the discussions while the task of the facilitator was to strive to include all participants. However, the interactions between the students led to in-depth data and a better understanding of the digital learning resources being tested and evaluated.

4.3.3 Study III: Quantitative pre-/post-test cohort study

Study III was designed to test the Suite of mLearning Tools co-designed in study II. All second- and third-year nursing students were invited to test the usefulness of the Suite of mLearning Tools for the learning and performing of B-PAS during clinical rotation. In total, 171 nursing students (second-year: *n* = 72, response rate = 45%; and third-year: *n* = 99, response rate = 90%) participated in this quantitative cohort study in autumn 2019 and spring 2020.

4.3.3.1 Data collection

Self-reported data were collected in autumn 2019 and spring 2020 via three different questionnaires, before and after one clinical rotation in both student cohorts.

Nurse Professional Competence Scale Short Form (NPC-SF): The NPC-SF with 35 items was used to measure nursing students' self-reported competence in nursing. The response scale was a 7-point Likert scale with the following response options: 1 = to a very low degree, 2 = to a relatively low degree, 3 = to some degree, 4 = to a neither low nor high degree, 5 = to some degree, 6 = to a relatively high degree, 7 = to a very high degree. A formula for calculating the total scores for each competence area converted into scores between 0 to 100 was provided in the manual (NPC Research group, 2018), where 100 indicates the highest possible self-reported competence score (Table 6).

Table 6. The competence areas and the calculation formula according to the manual for NPC-SF.

Competence areas	Calculation formula
Nursing Care (5 items)	(1+2+3+4+5)/35x100
Value-Based Nursing Care (5 items)	(6+7+8+9+10)/35x100
Medical and Technical Care (6 items)	(11+12+13+14+15+16)/42x100
Care Pedagogics (5 items)	(17+18+19+20+21)/35x100
Documentation and Administration of Nursing Care (8 items)	(22+23+24+25+26+27+28+29)/56x100
Development, Leadership, and Organization of Nursing Care (6 items)	(30+31+32+33+34+35)/42x100

A thorough description of the assumptions and steps for constructing an overall NPC-SF score are thoroughly described in paper 3. As this was a novel use of the NPC-SF, it was undertaken in accordance with Dr Nilsson.

Perceived confidence in performing B-PAS: Thirteen items measuring the students' perceived confidence in performing the examination techniques (outcome expectations for inspection, palpation, percussion, and auscultation) were developed for this study, due to the lack of an instrument to measure task specific confidence (see Table 4 in paper

3 for the specific items and Appendix 2 with items worded in Norwegian). A 7-point Likert scale was chosen to align with the NPC-SF questionnaire, with the following options: 1 = strongly disagree, 2 = disagree, 3 = disagree a little, 4 = not sure, 5 = slightly agree, 6 = agree, and 7 = strongly agree. The questionnaire showed high internal consistency (Cronbach's alpha of > 0.80). An overall confidence score in performing B-PAS (the sum score of all items) was constructed: a score of 0–100 (all items/13 x 100), where 100 indicates the highest possible perceived confidence score.

Both construct and content validity were ensured in the development of the confidence items (Polit & Beck, 2020). The creation of the items was (a) based on empirical evidence identifying that lack of confidence is a significant barrier for students performing PAS in clinical rotation (Birks et al., 2014; Douglas et al., 2015; Tan et al., 2021); and (b) in line with Bandura's (1977) theoretical perspectives on self-efficacy and his (2006) guidelines to constructing scales measuring confidence. In addition, the research group consisted of members with various expertise related to teaching B-PAS to both students and clinical supervisors and teaching in higher education; they also had extensive research experience related to using both quantitative and qualitative methods, as well as competence in scale development. The research group expertise also played significant role in establishing the content validity of the items. The third-year students in study II and two faculty members with PAS expertise (who were not a part of the research group) were asked to review the items critically and provide feedback regarding the wording of individual items. The students and faculty members provided valuable comments and thoughts on the language, structure, rating scale, and labelling of the rating options. The wording of the questionnaire items was refined according to this feedback.

Evaluation of the Suite of mLearning Tools: Seven items were created to evaluate the specific content of the Suite of mLearning Tools (see Table 3 in paper 3) and one item was created to evaluate the overall usefulness of the Suite of mLearning Tools. The same 7-point Likert scale was used as in the previous questionnaire items.

The same procedure for establishing the content validity of these items was carried out, with the research group specifying the items according to the research questions and

asking the third-year students to review the items critically and provide feedback regarding the wording of individual items.

4.3.3.2 Data analysis

The statistical package IBM SPSS (version 28) was used for the data analysis. Descriptive statistics were presented as frequencies with proportions for categorical data and as means with standard deviations and a range for continuous data. The procedure for handling missing data is described in paper 3. To compare the self-reported data before and after the clinical rotation, paired sample t-tests were used and Cohen's *d* was calculated to determine the degree of change and interpreted as a small (> 0.2), moderate (> 0.5), or large (> 0.8) effect size (Cohen, 1988).

Linear regression analysis was performed to identify factors associated with change in the students' self-reported competence, using the overall confidence in performing B-PAS score before clinical rotation, the overall NPC-SF score before clinical rotation, and the overall evaluation of the Suite of mLearning Tools after clinical rotation as predictor variables (see Table 6 in paper 3).

4.3.3.3 Strengths and limitations

The main strength of study III is its large sample size, with 171 participating students (62.86% of 272 students in the second and third year) at one campus (emphasizing the diversity of two nursing student cohorts), as well as the pre–post design. This large and representative sample also lays the ground for sound statistical analyses. The correlation analyses of the NPC-SF subscales greatly exceed the general rule that one needs at least 30 participants for correlation analysis (Creswell & Plano Clark, 2018). The large number of participants allowed the use of linear regression in the data analysis, as well as the factor analysis.

The study also established baseline measures for competence in nursing before clinical rotations in different educational years. These can be used in future studies to calculate power to establish the needed sample size. Since the current study is an exploratory study

with no previously established baseline measure for measuring change following clinical rotation, a power analysis was neither required nor possible.

Another important strength of study III concerns the new items for obtaining construct and content validity in the new questionnaires: 'Perceived confidence in performing B-PAS' and 'Evaluating the Suite of mLearning Tools'. The third-year students read through all the questionnaire items, while two faculty members read only the questionnaire items 'Perceived confidence in performing B-PAS'. The psychometric analysis of the confidence items in both cohorts show high reliability and the questionnaire items are sensitive to self-reported perceived confidence and changes over time.

The limitations of self-reported data must be considered. The nursing students may have reported according to an ideal or self-regard, rather than their actual performance or behaviour (Cook & Campbell, 1979; Kajander-Unkuri et al., 2016). Nevertheless, when the data were collected, it was explained as clearly as possible to the students how they should answer the questionnaire items. Moreover, it has been argued that self-assessment's internal consistency is often high (Ross, 2006). In Fitzgerald et al. (2003) study, students' self-assessment was consistent over various skills and tasks. However, the advantages of using a pre–post design in study III is that the students were familiar with the questionnaire. The other questionnaire items were constructed for the purpose of this study and need to be further validated, which represents a possible study limitation.

Another limitation is that the participants represent only one university, which influences the generalizability of the study's results. Lastly, it would have been interesting to have compared the individual students' use of the Suite of mLearning Tools related to their evaluation of the usefulness of the tools, but this was not possible in study III due to the General Data Protection Regulation.

4.3.4 Study IV: Convergent mixed methods study

Due to the COVID-19 pandemic, the clinical rotation in the first educational year had to be redesigned and customized for the first-year students. The clinical course was

redesigned and the Suite of mLearning Tools was included to focus on skills training in the course, among other material and assignments. The virtual simulation software – one of the digital resources in the Suite of mLearning Tools – played a significant role in creating learning situations that could be experienced 'clinically' and were thus relevant for clinical practice.

A convergent mixed methods approach was applied in study IV, where both quantitative and qualitative methods were used to collect data. This study is also the emergent component of this dissertation, as presented in chapter 4.1. Since this was a novel way of conducting a clinical rotation, both nursing students and faculty members were invited to participate in the study. A total of 24 nursing students (with a response rate of 44%) answered the online questionnaire, 2 students and 1 faculty member participated in individual interviews, and 3 faculty members participated in a focus group interview.

4.3.4.1 Data collection

Both quantitative and qualitative methods were used to collect data in June 2020. In total, six different sets of questionnaire items were used in study IV. Many of the questionnaire items used in the study were based on logical development as proposed by Onwuegbuzie and Johnson (2006).

Perceived confidence in performing B-PAS in future patient encounters: Fifteen confidence items were used – 13 from study III and 2 new items were added to the neurological assessment (see Table 6 in paper 4 for the specific items and Appendix 2 for items worded in Norwegian). Since the redesigned clinical course excluded learning situations in clinical rotation (due to COVID-19 restrictions), the students' assessed their confidence in future patient encounters with a 5-point Likert scale, with the following options: 1 = disagree, 2 = disagree a little, 3 = not sure, 4 = slightly agree, and 5 = agree.

The development of the confidence items in study IV are based on the development of the confidence items in study III, where construct and content validity were obtained based on empirical evidence (Birks et al., 2014; Douglas et al., 2015; Tan et al., 2021), theoretical perspectives (Bandura, 1977, 2006), and expert opinion regarding different

aspects (wording, scale, and content). The confidence items in study IV measured students' perceived efficacy expectations in performing the examination techniques in future patient care, while the confidence items in study III measured students' outcome expectations.

Evaluation of limited content of the Suite of mLearning Tools: Two items for evaluating the Suite of mLearning Tools content from study III were applied in study IV, with modification (see Table 5 in paper 4). The response scale was a 5-point Likert scale, with the following options: 1 = disagree, 2 = disagree a little, 3 = not sure, 4 = slightly agree, and 5 = agree.

The research groups expertise and experiences with the virtual simulation prior to the data collection contributed to establish content validity of these items.

Evaluation of the virtual simulation: Thirteen items were constructed to evaluate the different aspects of the virtual simulation (see Table 7 in paper 4). The students were asked to assess the impact of the virtual simulation with a 5-point Likert scale, with options from 1 (disagree) to 5 (agree).

The research groups expertise and experiences with the virtual simulation prior to the data collection contributed to establish content validity of these items.

Evaluation of the academic assignments: Eight items were created to evaluate the academic (written) assignments (see Table 8 in paper 4). The students were asked to assess the impact of the academic assignments with a 5-point Likert scale, with options from 1 (disagree) to 5 (agree).

The research groups expertise and experiences prior to the data collection contributed to establish content validity of these items.

Evaluation of the redesigned clinical course: Three items were constructed to evaluate the overall impact of the redesigned clinical course on students' confidence in their fundamental care and human bioscience knowledge (see Table 9 in paper 4). The

students were asked to rate the impact by using a 5-point Likert scale, with options from 1 (disagree) to 5 (agree).

Hours spent on the content of the Suite of mLearning Tools: Six new items were created to map the hours students spent per week while engaged with the different content in the redesigned clinical course (see Table 4 in paper 4).

Individual and focus group interviews were used to collect data. The individual interviews were conducted with 2 nursing students (lasting between 41 and 32 minutes) and one faculty member (lasting 38 minutes). Regarding the main features, the students and the faculty member were asked to elaborate on their experiences with participating in the redesigned clinical course – both in general and related to the different course content. The faculty member was also asked to share their experiences with supervising students in this new course. These interviews were conducted by the first author of paper 4 via a CVCS due to the COVID-19 restrictions. The participants consented to the interview being video recorded. The digital context of the interviews may have limited the non-verbal dimension in the conversation, leaving out the key dimension of a face-to-face interview.

The focus group interview in study IV included faculty members (*n* = 3) and was also conducted via a CVCS (lasting 56 minutes) by the first author of paper 4. The focus of the discussions was the same as in the semi-structured interview.

It was considered easier to facilitate the discussion with three participants in a CVCS, to ensure that all felt comfortable and had the opportunity to speak and share their opinions. As mentioned above, it was challenging to evaluate and take note of participants' non-verbal communication through a CVCS, leaving out the key dimension of a face-to-face interview. The faculty members consented to the interview being video recorded, and the purpose was the same as the recording of the individual interviews: i.e., to document what was being said in the interview, not to record the images of the person being interviewed.

4.3.4.2 Data analysis

Descriptive statistics were used to analyse the demographic data and the data from the questionnaires. The statistical package IBM SPSS Statistics (version 26) was used to perform the descriptive statistics analyses, for example determining the mean scores, frequency, standard deviation, range, and median scores.

The qualitative data were analysed using content analysis (Elo & Kyngäs, 2008). The first step of the analysis process involved an inductive analytical approach, in which the transcribed text material was read and the audio files were listened to, to obtain a comprehensive overview of the data and to understand the data material as whole. Thereafter, the analytical approach became more deductive. The analysis entailed identifying open coding, grouping codes into subcategories, and interpreting the subcategories into main categories. An example of the data analysis can be found in Table 2 in paper 4.

4.3.4.3 Strengths and limitations

A strength of study IV concerns our opportunity to use a mixed methods approach to explore new aspects of learning and personal experiences when participating in a new, redesigned clinical course. The participants' experiences are particularly unique, with regards to the fact that they took place during the COVID-19 pandemic: Their experiences thus have implications for post-pandemic educational practices.

Six sets of different questionnaire items were developed for the purpose of this study. The questionnaire items regarding confidence in performing B-PAS in future patient encounters constituted a modified version of questionnaire items used in study III, concerning perceived confidence in performing B-PAS. The strength of this modification was that the theoretical foundation is the same as in study III (Bandura, 1977, 2006). The expertise of the research group also played a significant role in establishing content validity in all six sets of questionnaire items. However, it may be considered a shortcoming that none of the sets of questionnaire items were piloted and tested prior to their use in study IV.

One important limitation of the study concerns the small sample size. The timeframe in which we could recruit students to the study was rather limited, with the summer holidays starting directly after the students' completion of the redesigned clinical course. Malterud et al. (2016) introduced the concept of information power regarding sample size in qualitative research, stating that 'the larger information power the sample holds, the lower *N* is needed and vice versa' (p. 1754). Despite low sample size, the students and the faculty members had large information power because of the novelty of the research focus and the participants' experiences in a disruptive situation.

The use of a paper-based questionnaire was the preferred method of collecting the survey data, as the use of an online questionnaire may contribute to a lower response rate. However, due to the COVID-19 restrictions, this approach was not possible in this study.

4.4 Research synthesis of the results of the four studies

One of the main characteristics of mixed methods research is the research synthesis and the integration of the results, driven by the quantitative and qualitative research methods (Creswell & Plano Clark, 2018). Highlighting coherence, complementariness, and even discrepancies in the four studies in the dissertation can increase the credibility of the overall results (Creswell & Plano Clark, 2018). It has also been emphasized that using joint displays to visualize the processes of integration is good method, which can take the form of tables, figures, or matrices (Plano Clark, 2019). A qualitative approach was taken to integrate and synthesize the results of this mixed methods study.

The research synthesis and integration pooled and categorized the main results in each study related to the dissertation's specific aims (see the joint display under each aim in chapter 5.5). With the overview, the synthesis consists of a qualitative interpretation and reflections pointing out the most important results within each aim, as well as how these results relate to the presented empirical, theoretical, and pedagogical perspectives (discussed in chapter 2). The overall synthesis is a visual presentation and discussion (see chapter 5.5 and Figures 12 and 13).

4.5 Research ethics

All the studies were conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013). In addition, the Norwegian Centre for Research Data (NSD) approved every aspect of all four studies (study I, no. 53525; study II, no. 462735; study III, no. 674624; and study IV, no. 674624). The Faculty of Health and Social Sciences at USN approved the studies (in 2017 and in 2019, and an amendment for study IV in 2020). The NSD was also consulted several times during the research process, with inquiries and reflections regarding the data protection processes in the different studies.

All the participants were informed both verbally and in writing about the studies, and they signed voluntary informed consent forms for each study. The informed consent form contained information about the (a) aim of the study, (b) participation, (c) voluntary nature of the participation, (d) storage of the research data, (e) opportunity to withdraw at any time, and (f) process of collecting informed consent, as well as (g) how to contact different members of the research team and other important individuals. In study IV, the participants received information regarding (a) why the interview via CVCS would be video recorded, (b) the storage of the video file, and (c) when the video files would be deleted.

Another important ethical consideration concerned the familiarity the students might have had with the PhD candidate and the other researchers involved with the four studies in the dissertation. During the data collection, a few of the researchers (including the Ph.D. candidate) lectured at the university campus in the undergraduate nursing education programme: in theoretical classes, the skill lab, or both. This concerned the PhD candidate in particular, who – at the time of the data collection – taught the theoretical courses and the B-PAS at the skill lab at the university campus. The potential consequence of this was that the students may have known the researchers while researchers might not have known the students. To mitigate the risk that this familiarity could influence the recruitment process, course leaders assisted with the recruitment, emphasizing the voluntary nature of the participation and that participation had no influence on the students' performance in the course. None of the researchers had any

responsibilities for grading the students' achievements in any courses, as the potential issue of a power imbalance in the researcher–student relationship was taken seriously by the researchers. The issue of power has been especially raised within PD studies (Bratteteig & Wanger, 2016). In the co-design workshops, the facilitators tried to ensure that all the participants had equal opportunity to share their thought and opinions about the topics addressed. The researchers were also conscious about staying in the background in the discussions, allowing the students to be in the foreground, but also engaging when needed to clarify or to ask follow-up questions or to facilitate for the discussions.

5 Results

The main results from the four studies are presented in consecutive order in the following text with the results of the research synthesis presented at the end of the chapter. A more detailed description of the results can be found in the published papers.

5.1 Study I – paper 1

Study I's main finding is that, despite reducing the content of PAS to B-PAS, the students' utilization of the skills in clinical practice is limited. Measured with the SETPN-30, the students' rated eight skills: Five in the heart and peripheral circulation assessment and three in the respiratory assessment were rated with a median score of 4.0 or higher in all student cohorts. The results indicate that these specific skills were used occasionally to regularly by the students when in clinical rotation. Of the 11 skills in the abdominal and neurological assessment, only inspection of the abdomen was reported to be used frequently (median = 4.0) by the second- and third-year students. Among the first-year students, none of the 11 skills reached a median rating over 3.0. The students thus rarely used all the skills in the neurological assessment. Furthermore, the students in all three cohorts used inspection and palpation more often than the more-technical examination techniques of auscultation and percussion. In their responses regarding what could support the use of B-PAS, the ranked order of students' preferences was as follows: (a) collaboration with peers, (b) more collaboration with nurses in clinical rotations, (c) increased facilitation from the supervising nurse, and (d) access to instruction videos and online courses.

The above suggestions for learning support were also highlighted in the focus group interviews. Several contextual facilitators/limitations were mentioned, especially the supervising nurse's attitudes towards B-PAS. The students also emphasized the importance of knowledge in fundamental nursing care and human bioscience topics when performing and using B-PAS.

5.2 Study II – paper 2

The digital learning resources tested and evaluated in collaboration between the students and the researchers/teachers in this study were instruction videos, video lectures, podcasts, a MOOC, virtual simulation software, and learning material designed specifically for auscultation skills (i.e., combining sound files, written text, and a collection of YouTube videos). The evaluation processes informed the co-design of the Suite of mLearning Tools. The co-design processes took place over two to three workshops when the students were in theoretical courses and in clinical rotations; the goal here was for the learning resources to be tested and evaluated in these two learning contexts in the nursing education programme.

In the co-design workshops, the students highlighted the usefulness of the multimedia learning resources, the virtual simulation, and the additional learning material. They explained that the instruction videos and video lectures could be useful for preparing to use B-PAS in direct patient care or when practising B-PAS with peers in the skill lab. The students highly valued certain aspects of the tool's functionality, such as the ability to replay and pause the videos as needed, along with overall good accessibility of the content of the Suite of mLearning Tools. The possibility to be selective regarding the learning material according to what they needed in that moment – in the different situations and learning contexts – promoted knowledge development and confidence in using B-PAS among the students.

The virtual simulation software and use of virtual patients created excitement among the students. They shared reflections around the possibilities of (a) using the software for learning human bioscience topics and (b) connecting this knowledge with other areas of knowledge within nursing education, which the students experienced as crucial for developing clinical reasoning skills. They also found the systematic assessment approach used to assess the virtual patient situation to be useful for learning how to apply B-PAS in patient care. Furthermore, the students emphasized that 'simulating' in a group rather than individually, with the presence of a faculty member, was important to create a safe learning environment. They also found that the virtual simulation setting created a safe

learning environment, in which they could make incorrect or suboptimal decisions without harming a real patient, and where the facilitation of the faculty member contributed to helping them reflect on and understand what they did incorrectly: so they could 'get it right', in relation to both skills and knowledge.

According to the students, it was important to include the additional learning material regarding auscultation skills and how to professionally document and communicate the results of B-PAS assessments. The reason for this was that they found the auscultation more challenging to perform than the other three examination techniques.

When assessing the 'pilot' version of the Suite of mLearning Tools, the second- and third-year students preferred the inclusion of all the digital learning resources that had been tested and evaluated in the co-design workshops. The main reasons for this were (a) the variety and complexity of individual learning preferences among students in nursing education and (b) that the usability of the Suite of mLearning Tools would increase if all the resources were included. Another suggestion from the students was to scaffold the learning material in the Suite of mLearning Tools based on 'unlocking' more advanced learning material, with the aim of triggering motivation and curiosity among the students. The students also communicated that the Suite of mLearning Tools and, more generally, the use of mobile technology was a promising feature in future nursing education.

5.3 Study III – paper 3

The main results of this study are as follows: first, confidence in performing B-PAS is an important aspect of students' overall competence in nursing and of all six competence areas defined by the NPC-SF; second, voluntary use of the Suite of mLearning Tools contributed to change in overall competence by supporting the increased use of B-PAS; and third, the overall competence increased significantly after clinical rotation in the second and third educational years.

The third-year students rated their confidence in using B-PAS considerably higher at the end of the clinical rotation (mean = 80.1, *SD* = 10.1) than the second-year students (mean = 69.4, *SD* = 12.2). The changes in the overall B-PAS confidence score among the third-

year students was statistically significant with a large effect size (Cohen's *d* = > 0.8), while the overall B-PAS confidence score among the second-year students was statistically significant but with low effect sizes (Cohen's *d* = > 0.2), indicating little change in confidence in using B-PAS during this clinical rotation.

The second- and third-year nursing students reported significant changes within all six NPC-SF competence areas after clinical rotation. The changes were measured as moderate (Cohen's *d* = > 0.5) or large (Cohen's *d* = > 0.8) in both groups, with the largest reported change related to *Nursing Care* and *Medical and Technical Care*. The second-year students reported the lowest moderate change within *Development, Leadership, and Organization of Nursing Care* (Cohen's *d* = > 0.53), whereas the third-year students reported the lowest moderate change related to *Care Pedagogics* (Cohen's *d* = > 0.72). Both the second- and third-year students reported large changes in the overall NPC-SF score (Cohen's *d* = > 0.8) between before clinical rotation and after clinical rotation. Both the second- and third-year students also reported large changes in the overall NPC-SF score (Cohen's *d* = > 0.8) between before clinical rotation and after clinical rotation.

Both student cohorts were asked to rate the individual content and the overall usefulness of the Suite of mLearning Tools. The third-year students reported that the overall usefulness of the Suite of mLearning Tools contributed to an increased usage of B-PAS to a relatively high degree (median = 6.0) compared to the second-year students, who reported that the Suite of mLearning Tools contributed to an increased usage of B-PAS to some degree (median = 5.0). According to the third-year students, the video lectures (median = 6.0, *SD* = 1.33) and the additional information about the auscultation (median = 6.0, *SD* = 1.28) contributed to an increased use of B-PAS in clinical rotation to a relatively high degree. Among the second-year students, only the additional learning material contributed to an increased use of B-PAS (median = 5.0, *SD* = 1.62) to some degree, and they were unsure whether the rest of the content in the Suite of mLearning Tools contributed to an increased use of B-PAS in clinical rotation.

The multivariable linear regression analysis with the overall NPC-SF score as the dependent variable and Confidence in Performing B-PAS and Perceived Usefulness of the

Suite of mLearning Tools – controlled by the NPC-overall SF score for the whole sample before the clinical rotation – showed that students reporting a high overall NPC-SF score before clinical rotation achieved a higher overall NPC-SF score after clinical rotation. A positive relationship was also found between the overall Confidence in Performing B-PAS score and the Perceived Usefulness of the Suite of mLearning Tools. The higher the self-reported overall B-PAS confidence score and Perceived Usefulness of the Suite of mLearning Tools, the higher the overall NPC-SF score after the clinical rotation, independent of which year they were in. The adjusted R^2 showed that this regression model explained 42% of the variance in the overall NPC-SF score after clinical rotation.

5.4 Study IV – paper 4

In this study, the most important findings were as follows: (1) A technology-enhanced learning environment may enhance students' preparedness for future clinical practice; (2) facilitation in virtual patient encounters can uncover the 'red thread' within nursing education, thereby fostering early development of clinical reasoning skills; and (3) new technology-enhanced learning activities call for new pedagogical competence among faculty members.

The quantitative results show that the different content of the redesigned clinical course supported the students in reaching the intended learning outcomes. They spent most of their time each week on academic assignments (mean = 14.9) and the least amount of time listing to the podcast (mean = 1.2). Most of the students used on average 4.4 hour per week on the B-PAS instruction videos and the video lectures. All the students (*N* = 24) agreed that this learning material helped them to understand the appropriate use of B-PAS in future patient encounters (mean = 4.6). When mapping the virtual simulation, the students' answers indicate that this learning activity increased their confidence in and understanding of the different aspects of systematically assessing a clinical situation, including the collection of subjective and objective patient data. The students' report also imply that the simulation with the virtual patients contributed to increased confidence regarding their understanding of how and when to use B-PAS in future patient encounters.

In the interviews, the students elaborated on their experiences in the simulation with the virtual patient, where the exploration of professional knowledge fostered development of clinical reasoning skills. They pointed out that it was challenging to make themselves vulnerable and reveal potential knowledge gaps by sharing their thoughts about and reflections on their interaction with the virtual patient. At the same time, the students also valued being able to articulate their thoughts, reflections, and clinical reasoning processes in the virtual simulation, as well as getting feedback on these intellectual processes from peers and the faculty member. The students appreciated that the facilitator acknowledged and respected their vulnerability, met their lack of knowledge without judgement, and challenged their theoretical understanding in a caring way. The process of systematically assessing the virtual patient's clinical situation also made important clinical 'cues' more explicit and noticeable while the students learned the appropriate nursing interventions. The students also drew attention to the possibilities offered by the virtual patients as a learning activity to merge theory and practice; however, they felt that the use of the virtual simulation should be anchored within good pedagogical strategies. Lastly, the students talked about how having flexibility around when they could engage with the available learning activities supported a good balance between their education and overall life responsibilities during the pandemic.

The faculty members experienced that the virtual simulations provided unique opportunities to explore the virtual patient's current physiological status consciously and systematically, while making the process of catching the clinical cues more explicit. They reported that these processes also emphasized the most important aspect of the facilitator role in the virtual simulations' sessions: thus to integrate different aspects of professional knowledge. The faculty members also found the ability to pause and stop the virtual patient case to be valuable, as this function provided an opportunity to reflect on the chosen actions and then explore what corresponding actions should be taken, thus promoting clinical reasoning. Working in a technology-enhanced learning environment – such as the redesigned clinical course, with its different digital learning resources (especially the virtual simulation) – also required more pedagogical and digital competence among the faculty members.

5.5 Synthesis of the four studies

In this section, the results from the four studies will be synthesized. The first three studies build upon each other's results, and the reported main results cohere with and complement each other. The fourth study emerged as an opportunity due to the COVID-19 pandemic and was conducted in a digital context; its results complement those of the other three studies.

All four studies explored different aspects of students' learning and performing of B-PAS in relation to (a) the concepts of competence and confidence and (b) the usefulness of the Suite of mLearning Tools, anchored within the Progression model. The main results highlight the complex landscape of learning and teaching in nursing education, especially related to the transition between the two learning contexts: the academic and the clinical context.

The implementation of B-PAS is relatively new in Norway, where the processes have been driven by the academic context, creating challenges and tensions related to performing these skills in the clinical context. The following research synthesis is structured according to the dissertation aims. The interpretation of the integrated findings is presented and supported by a joint display of the main results under each aim. Lastly, the integrated results are visually summarized and presented.

5.5.1 Synthesis – aim 1

The first aim in the dissertation was to explore the role of B-PAS in overall competence in nursing and person-centred fundamental nursing care. All four studies contributed to in answering the first overall aim. This will be explained in the following. Table 7 presents the joint display from the four studies.

Interpretation of the integrated results

When synthesizing the results, it became evident that **study III** contributed the strongest and most interesting findings regarding the relationship between students' competence and confidence in performing B-PAS.

The regression analysis in **study III** confirmed that overall confidence in performing B-PAS was an independent predictor of the overall NPC-SF score. Confidence in performing B-PAS correlated moderately to strongly with all six NPC-SF competence areas, and not just with the area of *Medical and Technical Care* and *Nursing Care* (these latter were the expected outcome). These results indicate that performing B-PAS is not just a collection of technical skills but an important component in overall competence in nursing and in all areas of competence measured by the NPC-SF. The NPC-SF competence areas mirror different aspects of fundamental nursing care, and since the students in **study III** reported increased overall competence in the second and third educational year, this can be understood as increased competence in fundamental nursing care. The correspondence between the performance of B-PAS and development of clinical reasoning skills is evident in **studies I**, **II**, and **IV**, indicating that performing and using B-PAS also involves clinical reasoning skills, which are a vital component of fundamental nursing care.

Table 7. A joint display showing how the main results from the four studies are pooled and categorized according to the methods used in studies.

Aim 1	To explore the role of B-PAS in overall competence in nursing and person-centred fundamental nursing care	
Study I	QUAN	• Sixteen B-PAS reached Cohen's *d* above 0.5 between the first and third educational years, indicating moderate changes between the students' cohorts. However, these results indicate that B-PAS becomes more integrated into fundamental nursing care during nursing education.
	QUAL	• Doing more than taking vital signs was challenging for the students and depended on the contextual factors. • The students emphasized the importance of basing the performance and use of B-PAS within fundamental nursing care and human bioscience topics.
Study II	QUAL	• The students wanted to include all the digital learning resources in the Suite of mLearning Tools. • The virtual simulation was seen as a good tool for integrating the human bioscience topics and fundamental nursing care, as well as for helping the students to develop clinical reasoning skills.
		• The overall competence in nursing measured by NPC-SF total score increased after each clinical rotation in both study years.

Study III	QUAN	• Confidence in performing B-PAS is an important part of overall competence, as well as in all the six competence areas measured by NPC-SF. • B-PAS can be considered an important component of fundamental care and overall nursing competence. • The student cohorts reported significant changes within all six NPC-SF competence areas after the clinical rotations. The changes were measured as moderate or large (according to Cohen's *d*) in both groups. Both student cohorts reported large changes in the overall NPC-SF score after each rotation.
Study IV	OUAN	• The virtual simulation helped the students to become more confident in their knowledge level related to fundamental nursing care and human bioscience topics.
	QUAL	• The exploration of professional knowledge in the virtual patient situations fostered development of clinical reasoning skills.

5.5.2 Synthesis – aim 2

The second aim of the dissertation was to explore how and to what extent a Suite of mLearning Tools could contribute to developing students' competence and confidence in performing B-PAS. When synthesizing the main results from the four studies, it became evident that the studies contribute to answering aim 2 to differing extents. Studies II and III contribute the strongest to answering the aim, while study IV offers complementary contributions from a new learning context, and study I supports the need for the development of the Suite of mLearning Tools. The joint display in Table 8, presented after the interpretation of the integrated results, shows how the main results from each of the four studies are pooled and categorized according to the methods in relation to aim 2.

Interpretation of the integrated results

The different content of the Suite of mLearning Tools was tested, evaluated, and used in different ways in studies II, III, and IV. According to the students in study II, the instruction videos and video lectures promoted seamless learning processes across learning contexts, and the inclusion of all the digital learning resources in the Suite of mLearning Tools could accommodate the students' different learning preferences. In study IV, the students reported that they used the instruction videos and video lectures on average

4.4 hours per week and that they engaged in the virtual simulation on average 3.5 hours per week. In Study III, the student groups had different views on the degree to which the Suite of mLearning Tools contributed to an increased use of B-PAS. While the third-year students reported that the content of the Suite of mLearning Tools contributed to an increased use of B-PAS to some degree and to a relatively high degree, the second-year students were unsure about the contribution of most of the content – but they did report that the information about auscultation skills contributed to an increased use of B-PAS to some degree.

It is evident in studies I–IV that having access to digital learning resources and a Suite of mLearning Tools can support students' learning and performing of B-PAS across the academic and clinical contexts. The Suite of mLearning Tools developed in study II was an important element in the regression analysis in study III and – together with the overall confidence in performing B-PAS – contributed to increased overall competence in nursing.

The virtual simulation as a learning resource was highly valued by the students (studies II and IV) and faculty members (study IV). As a facilitated learning activity, the use of virtual patients contributed to increasing students' confidence in systematically mapping a clinical situation and understanding the extent to which a nurse can use B-PAS (studies II and IV). Furthermore, the virtual simulation was experienced as a powerful tool to integrate fundamental nursing care and human bioscience topics when exploring clinical cues and learning clinical reasoning. The students experienced the virtual simulation as a safe learning environment in which to 'get it wrong' before 'getting it right', in the process of utilizing knowledge and 'skills'. The learning outcomes from exposing knowledge gaps, receiving feedback, and reflecting on actions was beneficial for developing clinical reasoning skills (studies II and IV). The use of the different content in the Suite of mLearning Tools in nursing education needs to be well rooted in pedagogical strategies, which calls for digital competence among faculty members (study IV).

Table 8. A joint display showing how the main results from the four studies are pooled and categorized according to the methods used in the studies.

Aim 2	To explore how and to what extent a Suite of mLearning Tools could contribute to the development of students' competence and confidence in performing B-PAS	
Study I	QUAN	• The students reported that access to digital learning resources could support an increased use of B-PAS when in clinical rotation.
	QUAL	• Digital learning resources were identified as a promising pedagogical strategy for enhancing learning and using B-PAS in clinical rotation.
Study II	QUAL	• It was valuable for students to be able to select the digital resources they needed in different situations and to access these anytime and anywhere, which enhanced their confidence in performing B-PAS. • The different digital learning resources contributed individually and collectively to learning professional knowledge and laying the foundation for clinical reasoning processes. • The B-PAS instruction videos and video lectures could be helpful when preparing to use B-PAS in direct patient care and when working with peers in the skill lab. • The virtual simulation with the virtual patient scenarios represented an exciting learning situation that promoted learning clinical reasoning skills and how to use a systematic assessment approach based on professional knowledge in nursing. • The students experienced that the virtual simulation could prepare them physically and mentally for clinical rotation, as they were able to safely explore actions in the virtual patient case. • The virtual simulation was a powerful tool that allowed both inaccurate and suboptimal clinical decision making in a safe learning environment. • The Suite of mLearning Tools can contribute to seamless learning processes, thus enhancing the transfer of skills and knowledge between different learning contexts. • After the recommendation from the students, all the digital resources were included in the Suite of mLearning Tools.
		• According to the third-year students, the video lectures and additional files for the auscultation contributed to an increased use of B-PAS to a relatively high degree, while the instruction videos contributed to an increased use of B-PAS to some degree.

Study III	QUAN	• The third-year students reported that the overall use of the Suite of mLearning Tools contributed to an increased use of B-PAS to a relatively high degree. • According to the second-year students, only the additional files for auscultation contributed to an increased use of B-PAS to some degree; the students were unsure whether the rest of the content of the Suite of mLearning Tools contributed to an increased use of B-PAS. • The second-year students reported that the overall use of the Suite of mLearning Tools contributed to an increased use of B-PAS to some degree.
Study IV	QUAN	• The first-year students spent on average 4.4 hours per week working with the B-PAS instruction videos and the video lectures, which helped them to understand the appropriate use of B-PAS in future patient encounters. • The first-year students spent on average 3.5 hours per week on the virtual simulation, which helped them to become more confident in collecting objective data (mean = 4.6) and to understand when to use B-PAS in future patient encounters (mean = 4.6). • The virtual simulation helped the students to become more confident in systematically mapping a patient in a clinical situation (mean = 4.5) and assessing the collected objective data; it also helped them to develop clinical reasoning skills and clinical decision-making skills.
	QUAL	• The exploration of professional knowledge in the virtual simulation fostered the development of clinical reasoning skills. • The virtual simulation was a safe learning environment to explore and reflect on one's own knowledge and potential knowledge gaps. • The students worried about being vulnerable and showing knowledge gaps while sharing their thoughts with the virtual patient. Yet, they also valued expressing their reflections and clinical reasoning in the simulation, and receiving feedback from peers and the faculty member. • It was important for the students that the faculty member was caring in their facilitation processes in the virtual simulation. • The faculty members experienced the virtual simulations as a unique opportunity to explore the virtual patient's current physiological status consciously and systematically, making the process of catching clinical cues more explicit for the students.

		• The virtual simulation created space for metacognition and addressed knowledge gaps among the students. • The need for more pedagogical and digital competence was highlighted by the faculty members.

5.5.3 Synthesis – aim 3

The third aim in the dissertation was to evaluate the usefulness of the Progression Model for students' confidence in performing B-PAS. When synthesizing the main results from the four studies, it became evident that **studies I–III** contributed greatly to meeting this aim, while **study IV** contributed to a smaller extent. Table 9 presents the joint display, which shows how the main results from each study are pooled and categorized.

Interpretation of the integrated results

The students reported an increased use of B-PAS (**study I**) and increased confidence in performing B-PAS (**study III**) between the different educational years. These results indicate that the students were increasingly working towards integrating B-PAS into their fundamental nursing care practice. **Study I** shows that the students appreciated the opportunity to train in and practise B-PAS with peers before they started their clinical rotation, which gave them a sense of preparedness and more confidence in performing B-PAS. The students also suggested that access to digital learning resources could support them in using B-PAS in clinical rotation. Despite the fact that the students increasingly used B-PAS throughout their education (**study I**), it was evident that contextual factors in their clinical rotation highly influenced (positively and negatively) their confidence in performing and using B-PAS, as well as which B-PAS were acceptable to use in patient care (**studies I** and **III**).

In **study III**, the second- and third-year students rated their confidence in performing B-PAS similarly at the beginning of the clinical rotation (median = 65.9/67.0). However, at the end of the clinical rotation, the third-year students reported a larger change in their confidence in performing B-PAS than the second-year students (median = 81.3/71.4).

The development of digital learning resources for teaching B-PAS seemed to be a beneficial component of the nursing education (**studies II**, **III**, and **IV**), by providing the

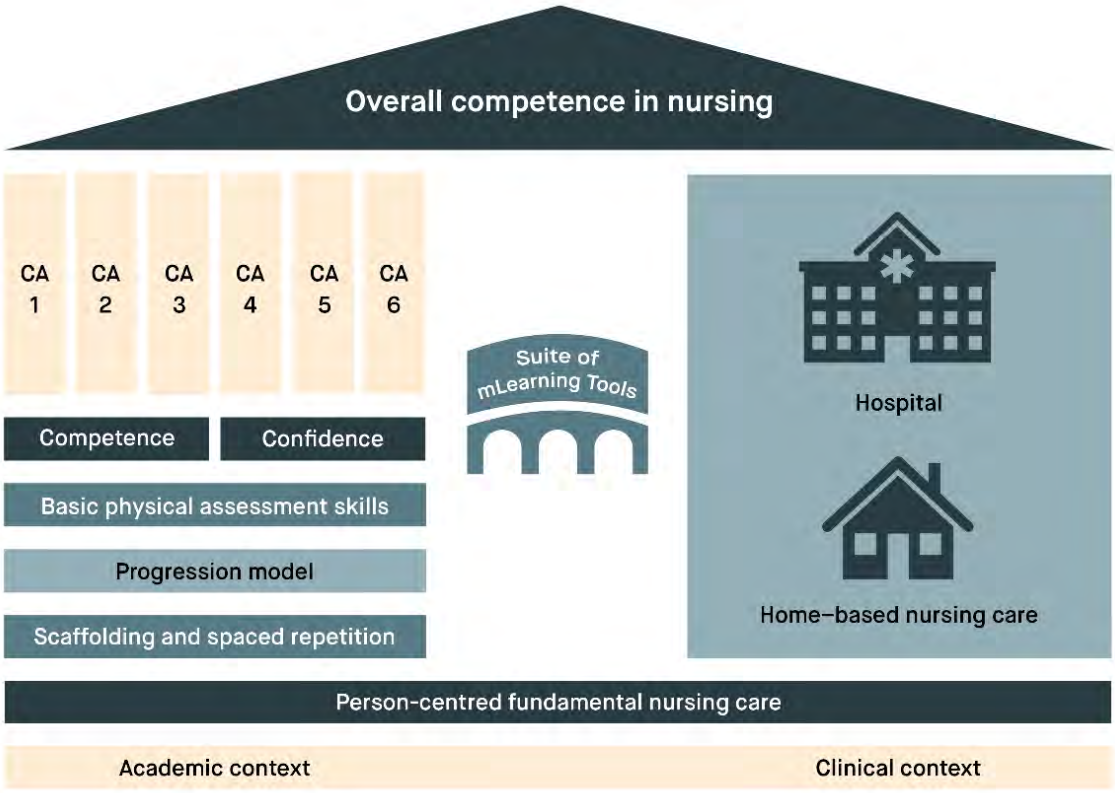
students with a 'digital' role model and bridging the two learning contexts. Study I shows that the students used inspection and palpation more often than the more technical examination skills of auscultation and percussion.

Table 9. A joint display showing how the main results from the four studies are pooled and categorized according to the methods used in the studies.

Aim 2	To evaluate the usefulness of the Progression Model for the development of students' confidence in performing B-PAS	
Study I	OUAN	• Most of the B-PAS use progresses with each educational year. • The students in all three cohorts used the auscultation and percussion less frequently than inspection and palpation.
	QUAL	• The students appreciated the opportunity to train in and practise B-PAS according to the Progression model before starting their clinical rotation, which gave them a sense of preparedness and more confidence in performing B-PAS. • Contextual factors in the clinical rotation and the supervisor's attitude towards B-PAS could facilitate or hinder students' development of confidence in using these skills. • Feedback from supervising nurses (and medical doctors) on the students' work with collecting different patient data often promoted clinical reasoning and students' confidence in using B-PAS.
Study II	QUAL	• It was valuable for students to be able to select the resources they needed in the different situations and to access them anytime and anywhere, and this was important for their confidence development in using B-PAS. • The instruction videos and video lectures were useful when the students prepared themselves to perform B-PAS in direct patient care and when training with peers in the skill lab.
Study III	QUAN	• The second-year students reported a small change (Cohen's $d = 0.4$) in their overall confidence in performing B-PAS during the clinical rotation, while the third-year students reported a large change (Cohen's $d = 1.2$) in their overall confidence in performing B-PAS.
Study IV	QUAN	• All the students agreed that the instruction videos and video lectures helped them to understand how to use B-PAS in future patient encounters.

5.5.4 Visual presentation of the research synthesis

The synthesis of the main results is presented visually in two figures. Figure 12 illustrates the results of the synthesis of the results from the four studies in the dissertation and Figure 13 illustrates the factors that encompass the learning and performing of B-PAS in a new model.



Note: **CA 1**=Nursing care; **CA 2**=Value-Based Nursing Care; **CA 3**=Medical and Technical Care; **CA 4**=Care Pedagogics; **CA 5**=Documentation and Administration of Nursing Care; **CA 6**=Development, Leadership, and Organization of Nursing care.

Figure 12. The research synthesis of the results from the four studies in the dissertation.

The aim with Figures 1, 2, 5 and 7 in chapter 2 is to illustrate how these different concepts encompass and influence all aspects performance of B-PAS. These figures led to the configuration of a new B-PAS model, in which a new circle was added (see Figure 13). This new circle highlights the influence of the metacognitive processes of clinical reasoning when performing B-PAS (the lightest green circle).

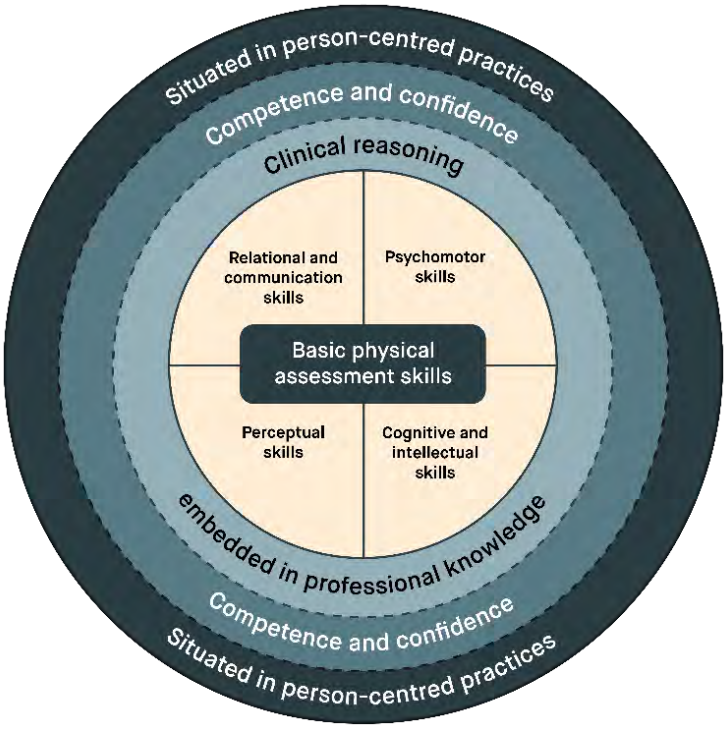


Figure 13. The B-PAS model based on empirical, theoretical, and pedagogical perspectives, as well as the results from the four studies in the dissertation.

At the core of the model are the B-PAS, with four fundamental pillars: relational and communication skills, psychomotor skills, perceptual skills, and cognitive and intellectual skills. The light green circle indicates the metacognitive processes in clinical reasoning, which is embedded in professional knowledge. By adding clinical reasoning as an independent dimension of performing B-PAS, increased attention is drawn to the importance of the cognitive aspects of B-PAS. In the future, this aspect of performing B-PAS should also be given more attention in the Progression Model and the pedagogical plan (Appendix 1). The performance of B-PAS as an essential part of fundamental nursing care is influenced by competence and confidence (the medium light green circle) and is situated and expanded in person-centred practices (the darkest green circle).

In the next chapter, the results from the research synthesis will be discussed in relation to the empirical, theoretical, and pedagogical perspectives presented in chapter 2.

6 Discussion

This is the first dissertation using a mixed methods exploratory sequential design to explore: (a) the role of B-PAS in overall competence in nursing and person-centred fundamental nursing care, (b) how a Suite of mLearning Tools can support students' development of competence in nursing and confidence in performing B-PAS and (c) the usefulness of the Progression Model for students' confidence in performing B-PAS. The discussion is structured according to the three overall aims of the dissertation. Methodological considerations regarding the mixed methods research design are also discussed in this chapter.

6.1 B-PAS and competence in nursing

The synthesis related to the first aim of the dissertation will be discussed in this chapter. First, the focus will be on students' reported confidence in performing B-PAS as an important part of overall competence in nursing, followed by their competence development as measured by the NPC-SF and the usefulness of this instrument in monitoring competence. Lastly, the results related to performing B-PAS as an integrated part of fundamental nursing care will be discussed.

6.1.1 Confidence in performing B-PAS and overall competence in nursing

The most surprising finding was that confidence in performing B-PAS was an independent predictor of overall competence in nursing, measured with the NPC-SF and controlled for students' scoring of confidence in B-PAS before clinical rotation (**study III**). This indicates that B-PAS should be viewed not only as a set of technical skills but as an integrated part of overall competence in nursing. This is a novel finding, as no other studies have explored this quantitatively.

The results of **study III** highlight the relationship between competence and confidence, which has been described as multilayered and intertwined (Gottlieb et al., 2021; Perry, 2011; Zieber & Sedgewick, 2018). This prompts reflection as to whether confidence can be developed without experiencing competence and vice versa. Gottlieb et al. (2021)

argue for the advantages of mapping both confidence and competence during education, stating that 'focusing solely on competence neglects the important dimension of confidence' (p. 38). The influence of confidence on perceived competence depends on how much responsibility the person is given to perform a task without supervision: If the context depends on a high degree of independence, the level of confidence is more crucial (Gottlieb et al., 2021). This means that, if students need to be more self-directed in performing B-PAS, their level of confidence in performing B-PAS will affect their skills application to a higher degree. This is highly relevant and interesting within a pedagogical perspective and underpins the usefulness of the scaffolding approach in the Progression Model (which is discussed in chapter 6.3).

Bandura's (1977) explanation of the information resources that influence confidence underlines the significance of students' interactions with others. Thus, confidence (and competence) grows through communication and interactions with nurses in the clinical rotation (as well as with other healthcare professionals). Culture, values, and beliefs in the work environment strongly influence and shape the students' confidence and competence during clinical rotation (Tan et al., 2021). Nursing students have also reported that the pedagogical environment and nursing supervision greatly influence their competence development (Kajander-Unkuri et al., 2014). A clinical learning environment that facilitates peer learning, reflective discussion, and supportive collaboration among the staff contributes to confidence in learning B-PAS (Byermoen et al., 2022). This also shows how the context of care as proposed by FoC framework can set the premises for delivery of care and facilitate for learning (Damsgaard et al., 2021; Laugesen et al., 2021).

The relationship between confidence and competence in nursing shown in study III highlights aspects of nursing education that need greater attention and focus. Newly graduated nurses describe having low confidence in using assessment skills in the first period post-graduation (Byermoen et al., 2023). The development of a student's professional identity starts on the first day of their nursing education and is shaped throughout their education, in both academic and clinical contexts. These development

processes then continue to be shaped in their transition to work life and during their professional career.

There has been an increased focus on measuring the level of competence among graduated nurses (Halabi et al., 2021), to enable discussion around the relationship between level of competence, patient safety, quality of care, and work experience. The results from **study III** emphasize the importance of confidence for students' level of competence, indicating that confidence adds a valuable dimension to the concept of competence.

6.1.2 Competence development and NPC-SF

Study III found a progression in students' development of competence between the educational years, measured with the NPC-SF. Among the second-year students, their overall NPC-SF score was a mean of 68.2 before clinical rotation and 77.4 after clinical rotation, while the third-year students' overall NPC-SF score was a mean of 76.0 and 83.5, respectively. These results show a significantly large change in both cohorts (Cohen's d = > 0.8). These results also indicate that a 'normal' and expected progression was achieved in students' competence during their education, which is positive from an educational perspective.

Only one study was identified that has investigated change in competence in one student cohort at four different time points during their nursing education (Høegh-Larsen et al., 2022). Other studies applying the NPC-SF measured competence among students at the point of graduation (Forsman et al., 2020; Lachmann & Nilsson, 2021; van de Mortel et al., 2021) and among nurses with more advanced experience (Halabi et al., 2021). The lack of studies makes comparison of the results from **study III** challenging; however, there are some similarities and parallels that can be reflected on between **study III**'s findings and those studies that have used the NPC-SF.

The benefits of tracking competence development for the purpose of educational and developmental needs has been highlighted by Pijl-Zieber et al. (2014), Finnbakk et al. (2015), Kajander-Unkuri et al. (2014), and Nilsson et al. (2018). The NPC-SF was

developed based on the competence requirements of undergraduate nursing education and is shown to be useful tool in assessing educational programmes (Nilsson et al., 2018).

The students in both cohorts in study III rated their competence to be highest in the areas of *Value-Based Nursing* and lowest in *Development, Leadership, and Organization of Care*. This aligns with other studies measuring competence with the NPC-SF in the third year (Høegh-Larsen et al., 2022) and at the point of graduation (Forsman et al., 2020; Lachmann & Nilsson, 2021; van de Mortel et al., 2021). *Value-Based Nursing* may represent an area within nursing education that receives more attention during education than *Development, Leadership, and Organization of Care*, which is often one of the areas of focus in the last educational year – at least in Norway.

These findings indicate that focusing on the competence areas receiving the lowest NPC-SF score might give the educational institutions important insights into how to best support students' learning during clinical rotations to increase competence in this area. Furthermore, increased awareness in clinical practice about competence areas that students find challenging at the point of graduation may be valuable, giving employers the opportunity to meet the learning needs that newly graduated nurses might have at the beginning of their career (Nilsson et al., 2014). The transition to becoming a newly graduated nurse can prove challenging: Indeed, it has been reported that 1 in 5 newly graduated nurses choose to leave the profession within 10 years post-graduation (Statistisk Sentralbyrå, 2017). Moreover, all levels of healthcare services are struggling to recruiting nurses, especially in the community healthcare services (NOU:4, 2023). Hence, there seems to be a need to continuously focus on competence development after graduation. This aligns with Byermoen et al. (2023) finding that newly graduated nurses highlighted a supportive work environment and nurse managers as key in successfully sustaining competence and confidence in the application of physical assessment.

In study III, the largest change in competence was in the areas of *Nursing Care* and *Medical and Technical Care*. Among the second-year students, the Cohen's *d* was 0.89 and 0.1, while among the third-year students, it was 0.82 and 0.88, respectively. Of the studies measuring competence with the NPC-SF (Forsman et al., 2020; Lachmann &

Nilsson, 2021; van de Mortel et al., 2021), only Høegh-Larsen et al. (2022) report on students' change in competence development by using Cohen's *d*. Høegh-Larsen et al. (2022) findings concur with the changes in competence development found in **study III**. These results may signal that students had the opportunity to focus on these two areas in their clinical rotation, both in hospitals and home-based nursing care. However, being able to master clinical procedures (such as taking vital signs or inserting a peripheral catheter) and providing fundamental care might be more easily assessable for the students than the areas of *Development, Leadership, and Organization of Care* or *Care Pedagogics*. This indicates that (a) it might be easier for the students to assess whether they can perform the clinical procedures or that (b) they can perform ordinary nursing tasks classified as providing fundamental nursing care.

6.1.3 B-PAS as an integrated part of fundamental nursing care

The research synthesis reveals the collective finding from **studies I–IV** that performing B-PAS should be considered an integrated part of fundamental nursing care.

In light of these results, the systematic approach of B-PAS based on examination techniques appears unfamiliar to many nurses in clinical practice in Norway. For some nurses, learning and performing B-PAS can be experienced as taking on tasks that should be undertaken by a medical doctor (i.e., role extension), while other nurses may feel that using B-PAS gives them increased opportunities within fundamental nursing care (i.e., role expansion; (Douglas et al., 2014; Lesa & Dixon, 2007). This underlines the uncertainty around expectations concerning nurses' performance and use of B-PAS. Role ambiguity and uncertainty among nurses is also described by Birks et al. (2014), Douglas et al. (2015), and Tan et al. (2021). The empirical literature regarding PAS does not question whether PAS is the domain of the nurse, but highlights that the use of PAS in clinical practice should mirror what is taught in nursing education (Birks et al., 2013; Douglas et al., 2016; Douglas et al., 2014; Giddens, 2006, 2007; Giddens & Eddy, 2009; Kohtz et al., 2017; Tan et al., 2021).

Government reports indicate that the need for healthcare professionals will only increase, especially in the more remote areas in Norway, due to more complex and chronic health situations, increased life expectancy, and reduced access to qualified healthcare professionals (NOU:4, 2023). In the government report 'Time to Act', interdisciplinary healthcare professionals (e.g., medical doctors, nurses, and nurse assistants) are urged to collaborate regarding task shifts. Task shifts have been highlighted as part of a sustainable solution to healthcare system challenges in Norway, based on the principle of having the right competence at the right time and at the right place, thus prioritizing patient safety and high-quality care (NOU:4, 2023). In this context, conducting a thorough assessment of the patient's clinical situation by using B-PAS can empower the nurse to effectively communicate the severity of the clinical situation to medical doctors or emergency services (Byermoen et al., 2023; Zambas et al., 2016). Conducting a thorough B-PAS can also help to reveal whether the clinical situation is less acute than initially perceived – or the opposite.

The competence areas measured by the NPC-SF align with all three dimensions in the FoC framework. *Development, Leadership, and Organization of Nursing Care* is a competence area that is essential to two FoC dimensions: the integration of care and the context of care. Further, competence in *Care Pedagogics* is highly relevant for the nurse–patient relationship (e.g., providing information about health issues to the patient and their family), the integration of care (e.g., providing information that can promote self-care), and the context of care (e.g., supporting co-workers or supervising members of healthcare teams). It can therefore be argued that the NPC-SF measures different aspects of fundamental care. Quality of care and patient outcomes depend on the establishment and characteristics of the nurse–patient relationship, which should be based on person-centred principles (Avallin et al., 2020; Byermoen et al., 2023; Kitson et al., 2018; Kitson et al., 2013). Thoroughly performed B-PAS can also promote feelings of trust and a mindful presence, with the aim of acquiring holistic knowledge about the patient.

Fundamental care has been described as implicit and invisible and is seldom highlighted beyond the first educational year in nursing education (Jangland et al., 2018). Jangland et

al. (2018) underline that the FoC framework enables the patient and nurse to assess confidently and competently, plan, implement, and evaluate fundamental care needs. The same authors explored the ability of nursing students to identify patients' fundamental care needs in three specific scenarios; they found that the students struggled to consistently identify all the fundamental care needs present in those scenarios (Jangland et al., 2018). Establishing the nurse–patient relationship is therefore a vital initial phase in identifying patient care needs, where communication and a person-centred approach constitute significant aspects (Avallin et al., 2020; Byermoen et al., 2023; Feo & Kitson, 2016).

The third-year students in **study III** viewed themselves as highly competent within the competence areas of *Nursing Care* and *Value-Based Nursing Care* after their clinical rotation. These findings concur with the results from the studies of Lachmann and Nilsson (2021), Forsman et al. (2020), and Høegh-Larsen et al. (2022) and suggest that students in their last year of education are becoming more competent in providing person-centred fundamental nursing care. This can also be interpreted positively in the assessment of the educational programmes. The results of **study I** also show that the frequency of using B-PAS increased from the first year to the third year, indicating that B-PAS were being increasingly integrated within fundamental care.

Byermoen et al. (2022) qualitatively explored nursing students' competence development related to performing B-PAS while in clinical rotation in the last educational year. One of their main findings was that, during the last year, the students developed and refined their systematic assessment approach, moving from a checklist-based approach towards a more holistic assessment, in which they were increasingly able to involve more communication with patients (Byermoen et al., 2022). This also implies an increased capacity among students to tailor their scope of practice to the patients' care needs.

When advancing the implementation of B-PAS in Norway, it is imperative that they are seen as a part of high-quality, fundamental nursing care in different contexts, and not just one of many 'tools' used in clinical practice. Zambas et al. (2016) demonstrate that, by

using PAS, students (and nurses) acquire valuable 'glasses' which enable them to detect deviations from normal health and identify potential issues before they escalate – thereby moving towards more proactive nursing care. Proactive nurses integrate systematic patient assessment approaches, such as B-PAS, into their scope of practice (Hoffmann et al., 2009).

In recent years, increased attention has been paid to patients' reports that their fundamental care needs have been unmet or delayed in various parts of the healthcare sector (Avallin et al., 2020; Chaboyer et al., 2020). The consequences of missed or delayed care needs are reduced quality of care, patient safety, and patient satisfaction (Avallin et al., 2020; Chaboyer et al., 2020). Different explanations have been suggested for why fundamental care needs are missed or unmet, including the considerable influence of the biomedical approach in nursing care (Avallin et al., 2020; Kitson et al., 2013). The nursing profession has advocated for the integration of mind–body interconnectedness in relation to individuals' experiences of health, illness, and coping (Davies et al., 2015). High-quality nursing care relies on all areas of professional knowledge; including fundamental nursing care and human bioscience knowledge. Embracing the systematic approach of B-PAS as an integrated part of fundamental care allows for the examination of a patient's physical appearance, vital signs, and body systems; this, in collaboration with the patient, facilitates the identification and integration of the patient's care needs.

6.2 Contribution of the Suite of mLearning Tools

The research synthesis indicates that the content of the Suite of mLearning Tools contributed to students' learning across learning contexts. The virtual simulation was shown to be a promising learning activity with opportunities for learning cognitive aspects of B-PAS (i.e., clinical reasoning skills).

6.2.1 Usefulness of the Suite of mLearning Tools

Studies II, III, and IV indicate that the Suite of mLearning Tools is useful in supporting the students' learning and use of B-PAS across learning contexts. Further, study III shows that

the Suite of mLearning Tools contributed to students' development of overall competence in nursing in different settings.

Based on the results of study I, the Suite of mLearning Tools in study II was developed to support the students in learning to perform B-PAS in different clinical contexts. Other studies testing different mLearning Tools with a narrow focus show that these successfully support students' learning of, for example, physical assessment, pharmacology, anatomy, physiology, and clinical skills (Barisone et al., 2019; Hsu et al., 2019; O'Connor & Andrews, 2016). The strength of the Suite of mLearning Tools lies in the variation of its digital learning resources, which accommodates students' varied learning preferences (study II). Different kinds of mLearning tool content (such as MOOCs, podcasts, instruction videos, multimedia presentations, and virtual simulations) have been suggested in the literature (Barisone et al., 2019; Hsu et al., 2019; O'Connor & Andrews, 2015, 2016; Vogt et al., 2010). However, our study appears to be the first to evaluate multiple forms of content, as these are included in the Suite of mLearning Tools.

The content of the Suite of mLearning Tools was experienced to be useful for learning B-PAS and to promote confidence in using B-PAS (study III). The instruction videos and information about auscultation were experienced as especially useful for confidence development (studies II, III, and IV). O'Connor and Andrews (2016) found a similar impact on student confidence from using the mLearning Tool developed in that study. Further, Hsu et al. (2019) found that physical assessment videos in a smartphone app supported students' use of physical assessment in clinical rotations, and that access to videos was a rapid way for students to learn how to perform physical assessment. In O'Connor and Andrews (2018) study, students ranked the use of mobile learning apps as the third most useful source of information when in clinical rotation, after peers and supervising nurses. When considering the lack of knowledge and experience among supervising nurses in clinical practice in Norway regarding B-PAS, some of the digital learning resources in the Suite of mLearning Tools may function as a 'digital' role model for the students. For instance, having access to instruction videos that demonstrate how to correctly perform B-PAS and the examination techniques (especially auscultation), as well as how to

interpret the different sounds, were useful in supporting the students in becoming more confident in performing B-PAS.

Another strength of the Suite of mLearning Tools involves the possibility of further refinement to increase its accessibility for a wider range of users. Implementing mLearning in clinical practice can enhance necessary digital competence among nurses in future healthcare services (Dunleavy et al., 2019). McDonald et al. (2018) point out that the use of digital technology for learning can provide graduated nurses with increased 'practice-readiness' and contribute to a stronger workforce within nursing. Byermoen et al. (2023) findings show that newly graduated nurses need to be supported in their work environment to continue their development of competence in assessment skills. By having access to a Suite of mLearning Tools, new possibilities for continuous learning assessment skills can be created and support newly graduated nurses to perform B-PAS.

The faculty members in study IV communicated the need to feel more competent regarding pedagogy in a digital context. This aligns with the findings of McDonald et al. (2018) review; the authors underline that strategies for developing and utilizing mLearning tools and digital technology in nursing education call for increased digital competence among faculty members. This competence has been referred to as 'pedagogical digital competence': the ability to understand and explore how to learn with and from technology (Jobst et al., 2022). To successfully utilize the potentials of mLearning and digital technology within nursing education, it is important to strengthen pedagogical digital competence among faculty members and provide them with necessary support (Bogossian et al., 2015). As McDonald et al. (2018) argue, substantial time and resources should be dedicated to planning e-based courses or programmes (here also understood as mLearning tools), to ensure pedagogical quality and competence among faculty members.

6.2.2 Bridging the academic and clinical context

The results of studies I and II demonstrate the various challenges that students face when applying skills and knowledge in a clinical context that they acquired in an academic context. The results of studies II, III, and IV show that the Suite of mLearning Tools may have promise for supporting students in transferring skills and knowledge between learning contexts.

The learning of clinical skills (such as B-PAS) is a complex learning process that requires frequent and continuous opportunities to practise (Byermoen et al., 2022; Ewertsson et al., 2017). Bandura (1977) states that an individual can feel confident in performing a specific task in one context, and later experience a lower level of confidence when performing the same task in another context; thus, students can have confidence in performing B-PAS in the skill lab with peers, but then feel less confident when they perform these skills in clinical rotation. The students in studies I and II elaborated on how challenging it could be to perform B-PAS. The taking of vital signs (NEWS) is a task that is routinely performed by and delegated to students, but to perform more B-PAS (for example, auscultation) was experienced as quite challenging and highly dependent on the supervision and clinical context. This limits the opportunity for the students to grow confidence in performing, as Bandura (1977) describes how observing others doing specific tasks is a robust learning mechanism for changing behaviour and growing self-efficacy (confidence).

Since the implementation of B-PAS in our university's nursing education is relatively new (and still evolving), many nurses supervising students in clinical rotation are unfamiliar with the objectives and aims of B-PAS and may lack the confidence or competence to perform B-PAS themselves. This can challenge their ability to facilitate and support the students in performing B-PAS during clinical rotation (Byermoen et al., 2021; Byermoen et al., 2022). This can also lead to that the students do not identification of similarities across the learning contexts, such as the use of B-PAS, which can prevent skills and knowledge acquired in the academic context from being applied in the clinical context (Ewertsson et al., 2017). This underlines the importance of providing dedicated support

to students in skills and knowledge transfer and fostering seamless learning processes and embedded use of B-PAS across learning contexts (Chan et al., 2006; Ewertsson et al., 2017). The Suite of mLearning Tools represents a potential effective pedagogical strategy to support bridging the learning contexts.

The third-year students in study III reported greater change in their overall confidence in performing B-PAS after having been in clinical rotation in the home-based nursing care setting. It is interesting to reflect on whether students find it less challenging to transfer B-PAS and related knowledge to clinical rotations in home-based nursing care (which is a part of the community healthcare setting) than they do in, for example, hospital settings. This brings forward the challenges of role ambiguity (or 'who does what') related to performing PAS – or, in the context of this dissertation, B-PAS (Douglas et al., 2014; Tan et al., 2021). In Norway, nurses in community healthcare face different challenges than nurses in hospital settings. Challenges such as long distances to medical doctors or pre-hospital services demand systematic approaches to assessing patients' clinical situation, precise communication regarding the severity of the clinical situation, and the use of clinical reasoning skills (Berg et al., 2021; Vatnøy et al., 2019). These challenges and work environments within community healthcare (including home-based nursing care) can play a significant role in prompting nurses to acknowledge B-PAS as a valuable set of skills with which to provide holistic, high-quality care (Byermoen et al., 2023; Byermoen et al., 2021; Fournier et al., 2021).

6.2.3 Promoting clinical reasoning through virtual simulation

Among the digital learning resources in the Suite of mLearning Tools, the virtual simulation was viewed by the students in study II, as well as the students and faculty members in study IV, to be a powerful tool for learning clinical reasoning skills and integrating fundamental nursing care and human bioscience knowledge.

Virtual simulation has emerged as an app-based learning activity promoting various learning outcomes, such as clinical reasoning, clinical decision making, skill development, and student preparedness for clinical rotation (Bogossian et al., 2015; Foronda et al.,

2020; Foronda et al., 2018; Koivisto et al., 2016; Kononowicz et al., 2019; Padilha et al., 2019). The students can interact with virtual patients, with a range of various options, such as communicating with the patient, choosing physiological parameters to monitor, conducting a physical assessment, performing nursing interventions, and administering medications (Flo et al., 2021). The possibility to pause and stop the virtual patient case at any time during the simulation is another valued feature, as reported by the students in studies II and IV, which corresponds with Flo et al. (2021) findings.

Clinical reasoning involves the collection of diverse information about the patient's situation, followed by cognitive processes to assess and reconstruct that information, which initiates nursing interventions and reflection on the process (Levett-Jones et al., 2010). Clinical reasoning also depends on the nurse's earlier clinical experience and professional viewpoint and is considered the key to high-quality and safe patient care (Levett-Jones et al., 2010; Zambas et al., 2016). Another foundation of clinical reasoning consists of all aspects of professional knowledge in nursing, including human biosciences topics (Levett-Jones et al., 2010); however, the value of human bioscience knowledge within clinical reasoning and its integration with fundamental nursing care seems to be lacking in nursing education (Jensen et al., 2018).

In the virtual simulation in study IV, special attention was given to how these areas of professional knowledge could be integrated in the dialogues with the first-year students. By asking questions aimed at integrating the human bioscience topics and nursing care, the students were constantly reminded to try to think about and verbalize the integration of these two areas of knowledge.

Debriefing is considered the cornerstone of all simulation-based learning (SBL); it comprises a distinct, instructor-facilitated phase in SBL, in which the participants retrospectively reflect on the actions taken in the simulation session (International Nursing Association for Simulation and Learning [INACSL], 2016). The facilitated virtual simulation sessions in studies II and IV reveal the value of being able to stop and pause the simulation case, to enable students to reflect 'on actions in action'. This continuous reflective debriefing in the virtual simulation also enabled the facilitator to potentially be

a role model in terms of how to conduct clinical reasoning, how to integrate fundamental nursing and human bioscience knowledge, and how to think and speak like a nurse (studies II and IV). Clinical reasoning involves hypothetico-deductive cognitive processes: Clustering clinical cues and reconstructing information are skills that can be trained, learned, fostered, and embedded in professional knowledge based on reflexivity (Malterud et al., 2019). The most valuable results for the students from the use of virtual simulation were learning to understand the value of performing B-PAS, catch clinical cues, and use professional knowledge to perform clinical reasoning in relation to a clinical situation (studies II and IV). For faculty members, helping students make connections between different areas of professional knowledge in the context of the virtual patient's clinical situation is a way to role model clinical reasoning – while also addressing suboptimal reasoning and providing constructive feedback to students.

Exposing knowledge gaps and receiving constructive verbal feedback were considered by the students in studies II and IV to be highly beneficial for developing clinical reasoning skills: i.e., 'getting it wrong' before 'getting it right'. The facilitator's person-centred feedback and adjustment of suboptimal actions in a virtual simulation has been found to contribute to successful student learning (Koivisto et al., 2016). This underlines that facilitation in virtual simulation seems to entail certain characteristics requiring personal, communicative, professional, and formal pedagogical qualifications. In addition, Bandura's (1977) four information resources – performance accomplishments, vicarious experiences, verbal persuasion, and emotional arousal – play a valuable and vital role in supporting students in developing confidence in their cognitive processes. When learning clinical reasoning in game-based simulation, such as virtual simulation, the usability of the software, application of professional knowledge, and exploration of one's own actions are the elements that significantly affect students' learning outcomes (Koivisto et al., 2016).

Although virtual simulation was shown to be a valued learning activity for various learning outcomes in this dissertation, further research is needed. There is also the need to explore the added value of this kind of simulation in the larger landscape of simulation

research and in relation to the more traditional simulation activities in nursing education, such as high-fidelity simulation. The facilitator role in the virtual simulation should also be addressed, as the 'human in the loop' needs to be further explored, along with suitable debriefing methods in the virtual simulation.

6.3 Usefulness of the Progression Model

The research synthesis indicates that the Progression Model for teaching B-PAS may be beneficial for building students' confidence (studies I, II, and III). Further, to reinforce and sustain the development of confidence, students need role models and supervision in the clinical context that facilitate and encourage the students to perform B-PAS as a part of fundamental nursing care (studies I and II).

The Progression Model is an innovative student-centred approach in which the emphasis is on repetitive practise and learning the clinical value of performing B-PAS within fundamental nursing care. Internationally, PAS are often taught as a block approach, with the full range of skills (usually about 126) being taught in a single course (Birks et al., 2014; Lesa & Dixon, 2007; Secrest et al., 2005). McDonald et al. (2018) highlight the importance of considering students' cognitive load when introducing nursing assessment via electronic format in the curriculum. The use of scaffolding can prevent advanced learning material from being presented too early (McDonald et al., 2018). In the Progression Model, scaffolding is one of the pillars, moving from the 'simpler' actions towards more complex and comprehensive use of B-PAS involving situation awareness, critical thinking, and clinical reasoning. As Gottlieb et al. (2021) explain, when one is certain about a specific task, this can generate the confidence to perform that task. If the outcome of the action is reinforced, this further generates a feeling of certainty, which in turn creates a sense of confidence. The spaced repetition or the repetitive component of the Progression Model thus repeatedly trains students in the examination techniques and in performing B-PAS in different contexts, with the aim of enhancing students' confidence. Continuous practise of physical assessment seems to be a key factor in becoming more confident in applying the skills and ultimately moving towards increased internalization of the skills within fundamental nursing care (Byermoen et al., 2022)

The results of study I show that (a) students' frequency of performing B-PAS and (b) the opportunity to practise with peers before the clinical rotation contributed to students' sense of being prepared for learning in the clinical rotation. In addition, as mentioned in chapter 6.1.1, study III found that the level of confidence increased between educational years. While we cannot conclude that this is directly related to the Progression Model, it is interesting to reflect on whether the repeated emphasis on assessment skills over the years strengthened the foundation for building students' confidence in performing B-PAS.

Building confidence in performing B-PAS does not happen in a vacuum in the academic context. The development of confidence (and perhaps also competence) must be reinforced and sustained in the clinical context. The students' experiences in studies I and II highlight that they lack role models in how to perform B-PAS as a part of fundamental care in clinical rotation. These findings are supported in the studies of Byermoen et al. (2021) and Byermoen et al. (2022). The lack of role models has been identified as a common barrier for students' use of physical assessment (Tan et al., 2021). One consequence may be the absence of valuable learning situations in which students can practise B-PAS in authentic patient encounters, leading to reduced opportunities to experience both efficacy and outcome expectations.

Bandura's (1977) perspectives offer valuable understanding and knowledge about what strategies could and perhaps should be emphasized when reinforcing and sustaining students' confidence in performing B-PAS. For example, observing others performing B-PAS with verbal and constructive feedback represents a powerful tool for developing confidence (Bandura, 1977).

Findings from studies I and II reveal an absence of feedback and, in some cases, an unsupportive attitude concerning students' use of B-PAS and their initial assessment of clinical cues. A potential consequence of the resistance some nurses and ward environments display towards students performing B-PAS is that students may in turn develop a negative attitude towards performing and integrating B-PAS in fundamental nursing care. A supportive learning environment and supervisor can also have a positive

effect on students' performance of B-PAS and help them to integrate these skills into fundamental nursing care (Byermoen et al., 2023; Kajander-Unkuri et al., 2014). These different scenarios exemplify what Ewertsson et al. (2017) call the situated power of the ward environment in clinical practice. This shows that the academic and clinical contexts may not always harmonize and underlines the importance of close collaboration between the key stakeholders in both contexts, with regards to educating nursing students.

Although the Progression Model proved to be beneficial for students' confidence, it should be further refined to continuously focus on tailoring the learning activities to students' learning needs. There is also a need to collaborate with clinical practice to inform the pedagogical thinking behind the Progression Model and to find the common ground necessary to grow students' confidence in performing systematic physical assessment within person-centred fundamental nursing care.

6.4 Methodological considerations

The focus of this section is on the quality and validity of the complex mixed methods research conducted for this dissertation. While Onwuegbuzie and Johnson (2006) view quality and validity as synonymous concepts, Creswell and Plano Clark (2018) highlight explicit challenges related to the specific mixed methods research design. These concepts are thus discussed separately in this section. The validity of the qualitative research synthesis of the four individual studies' main results is also discussed. The strengths and limitation of each study are presented in chapter 4 and are therefore not addressed in this methodological discussion.

6.4.1 Quality and complex mixed methods research design

Quality assessment of mixed methods research has been debated in the literature, primarily revolving around the core components of a quality assessment, as well as the scope of the applicable quality criteria (Creswell & Plano Clark, 2018; Fàbregues & Molina-Azorin, 2017; Guetterman et al., 2023; Hirose & Creswell, 2023; O'Cathain et al., 2008). Quality assessments are linked to multiple aspects of the different phases in a research project: planning, undertaking, interpreting, and disseminating (Fàbregues &

Molina-Azorin, 2017; Fàbregues et al., 2019; Hirose & Creswell, 2023; Onwuegbuzie & Johnson, 2006). The research disciplines of nursing, psychology, education, and sociology have different views on how quality within mixed methods research should be addressed and conceptualized in studies (Fàbregues et al., 2019). Nursing and psychology seem to value the use of a more standardized approach to assessing quality, for example in the form of a checklist (Fàbregues et al., 2019) – such as the Good Reporting of a Mixed Methods Research Study (GRAMMS; O'Cathain et al., 2008). Sociology and education lean towards valuing a more flexible approach to quality assessment (Fàbregues et al., 2019). In their study, Fàbregues et al. (2019) found that the quality criteria described in the literature concurred with researchers' views and practices, but also identified that the main features of quality assessment involved (a) the integration of the quantitative and qualitative data and (b) the justification of using an mixed methods research approach. In addition, it is important to accept the diversity of quality assessments, as these represent the uniqueness of each research discipline (Fàbregues et al., 2019).

In an attempt to help new researchers to better understand the concept of quality assessment in their mixed methods research studies, Hirose and Creswell (2023) propose six quality criteria: (1) advance a rationale for the use and appropriateness of mixed methods methodology, (2) write quantitative, qualitative, and mixed methods questions or aims, (3) report the quantitative and qualitative data separately, (4) name and identify the type of mixed methods design and present a diagram of it, (5) state the use of integration in a joint display, and (6) discuss how meta-inferences and value resulted from the integration analysis. These quality criteria guide the discussion of the quality of this dissertation's research design.

As stated in chapter 4.1, the research design in this dissertation is viewed as complex mixed methods research. As explained, the overall research design is classified as an exploratory sequential design, in line with Creswell and Plano Clark (2018). However, the addition of convergent and emergent components illustrate the complexity of this dissertation's design, together with the three points of integration. As Schoonenboom and Johnson (2017) advocate, research designs in complex mixed methods research

studies can often include combinations of designs, going beyond classifications and typologies. The research design should therefore be tailored to the study aim (Schoonenboom & Johnson, 2017). The convergent component was applied in studies I and IV and the emergent component was the development of study IV (see chapter 4.1). The dissertation's three aims informed the exploratory approach, based on the four individual studies (I–IV). The sequential component underlines how the results from study I influenced the aim and the research questions in study II, which established the premises for study III.

In the original project plan for studies I–III (with the fourth study emerging during the research process), the mixed methods research design was considered the best approach because of the scarcity of research related to the central topics under investigation. The methodological decisions made in the process of conducting the individual studies were aimed at strengthening the body of research, and were based on open discussion and reflection among the researchers involved in the studies.

In this dissertation, the assessment of the quality of the mixed methods research design is based on the six quality criteria propose by Hirose and Creswell (2023) and are presented in Table 10.

Table 10. Quality assessment of the complex mixed methods research design.

Quality criteria	Quality criteria addressed in the dissertation
1	The rationale and justification for the mixed methods research is presented in chapter 4. The main characteristics of the mixed methods design – the purpose, timing, planning, points of integration, and complexity – are also presented in chapter 4.1. In that section, a procedure diagram of the exploratory sequential mixed methods design with the convergent and emergent components is provided.
2	In chapter 3, the three mixed methods aims of the dissertation are presented. They are also assessed to be in line with an exploratory mixed

	methods design. The aims and research questions in studies I–IV cohere with the design and research methods used in each study.
3	The dissertation has two studies with convergent mixed methods design (studies I and IV), one qualitative study (study I) and one quantitative study (study III). In studies I and IV, the quantitative and qualitative data are presented separately; in study IV, the integrated results are presented in a joint display. In the single method studies (II and III), the data are presented according to the specific method. See chapter 4.3.1–4.3.4 and papers 1–4.
4	In chapter 4, the overall research design is presented as an exploratory sequential design with an emergent component, via a diagram showing how the first three studies are interrelated and when the fourth study emerged. Studies I–III represent what can be referred to as the different phases in the mixed methods research design.
5	The research conducted in this dissertation has three points of integration, which are explained in chapter 4.1 in Table 1.
6	The method of the qualitative synthesis in this dissertation is presented in chapter 4.3. The results from the synthesis are presented in chapter 5.5, in accordance with the three overall aims of the dissertation. In the synthesis, the main results from the four studies are pooled and categorized to identify complementarity and discrepancies in the findings. To a varying extent, the individual studies contributed to answer the three overall aims in the dissertation. The results from the synthesis are discussed in chapter 6.0.

6.4.2 Validity of the qualitative synthesis

A mixed methods research synthesis may be a quantitative or qualitative systematic review of the results of qualitative, quantitative, or mixed methods studies (Sandelowksi et al., 2012). The aim of a research synthesis is to advance new understandings and the value of the research findings, taken as a whole. A qualitative synthesis approach was taken to review and to aggregate the research synthesis, according Sandelowksi et al. (2012). Undertaking a research synthesis has been described as a complicated process,

especially since the literature describes more than one way of doing so (Creswell & Plano Clark, 2018; Plano Clark, 2019; Sandelowksi et al., 2012). In this dissertation, the qualitative synthesis involved process of aggregation of the main results from the four studies (Sandelowksi et al., 2012).

The trustworthiness of qualitative research is often presented as the sum of the concepts of credibility, dependability, conformability, and transferability (Lincoln & Guba, 1985). The text below addresses these concepts related to the qualitative research synthesis. As described in chapter 4, the setting of this dissertation research was one campus at a large, multi-campus university, in which the Progression Model for teaching B-PAS was developed and implemented. As the aims for the dissertation set out to explore the different aspects related to B-PAS (competence, confidence, and fundamental nursing care), a purposive sampling strategy was used to recruit participants (as thoroughly outlined in chapter 4.2.1–4.2.4 and papers 1–4.) The limited sample size in study IV may weaken the dissertation's credibility; however, in studies I–III, the samples can be considered adequate related to the research methods used.

To our knowledge, we are the first university to have developed a Progression Model and systematically implemented B-PAS in three-year nursing education in Norway. However, nursing education in Norway adheres to the same NLOs and should therefore be very similar nationally. The characteristics of the participants in the four studies represent diversity in terms of gender, age, ethnicity (to some degree), and work experience. However, neither the learning preferences nor digital competence of the faculty members and students were mapped in the individual studies. Moreover, the results from the research synthesis can be an inspiration for curriculum changes at other universities, which can adapt or refine the Progression Model.

To strengthen the credibility of the research synthesis, two researchers collaborated in the process of aggregating the main results by using pooling and categorization towards a new understanding of the main results from the individual studies. The synthesis process is characterized by reflective discussion regarding the meaning of the individual study results in relation to the dissertation's aims. The presentation of the synthesis

contributes to strengthen the dependability of the processes by providing a detailed description of the analysis, presented in text format as well as with three joint displays of the results from studies I–IV in chapter 5.5.1–5.5.3 and in visual format in chapter 5.5.4.

6.4.3 Validity and the complex mixed methods research design

Creswell and Plano Clark (2018) define validity as 'employing strategies that address potential threats to drawing correct inferences and accurate assessments from the integrated data' (p. 251). The authors recommend that threats to validity in mixed methods research should be viewed in relation to the specific research design: in this case, the complex mixed methods research design. Three possible challenges related to exploratory sequential design are as follows: (1) not building on the quantitative elements based on the qualitative results, (2) the lack of a rigorous quantitative element, and (3) having the same participants in both the quantitative and qualitative samples (Creswell & Plano Clark, 2018). Because of the convergent component in the overall research design, the challenges related to the convergent design are also added to the overall validity evaluation. These are (1) not using similar concepts in the data collection for both methods, (2) unequal sample sizes in the quantitative and qualitative data collection, (3) keeping the results from the two methods separated, and (4) failing to resolve disconfirming results (Creswell & Plano Clark, 2018). Table 11 presents the measures that were taken in the dissertation to address validity challenges related to the exploratory sequential design (numbers 1–3) and convergent design (numbers 4–7).

Table 11. Validity assessment of the complex mixed methods research design.

Validity challenges	Measures taken
1	Measures were taken to secure quality in every step of the research process in all four studies. In studies I, III, and IV, quantitative methods were used, including validated instruments (the NPC-SF and the SETPN, modified to SETPN-30). Moreover, specific questionnaire items were created for the purpose of studies III and IV, due to a lack of instruments and to measure the topic of interest in the studies. Construct and

	content validity were obtained within the confidence items, where content validity was established related to the rest of the items used, only in study IV. See chapter 6.4.4 for a more detailed discussion about the quantitative methods. Various quantitative data analyses were used in studies I, III, and IV: descriptive analysis, effect size, reliability analysis, regression analysis, correlation analysis, and factor analysis. To ensure quality in the data analysis process, the PhD candidate worked with members of the research team who had expertise in this field; she also collaborated closely with a statistician in study III, as this study involved the most complicated data analyses.
2	The participating student cohorts were the only available student cohorts to recruit to the studies. No other university or university college in Norway offers the same Progression Model for teaching B-PAS as that implemented at our university. Therefore, a purposeful sampling strategy was used in all four studies. While this may limit the generalizability of the results, they nevertheless provide valuable and novel knowledge regarding students' competence in nursing, the relationship between students' confidence and competence in performing B-PAS, and the usefulness of the Suite of mLearning Tools in supporting the use of B-PAS in clinical rotation.
3	Studies I–III are sequential. The overall contribution of the quantitative and qualitative methods proved equally important for the process of creating new knowledge in this dissertation.
4	In studies I and IV, the same key concepts comprised the aim in both data collection processes. In study I, the use of B-PAS among the students was explored. In the quantitative data collection, the frequency of B-PAS among the students was measured, while in the qualitative data collection, the students were asked to elaborate about facilitating or hindering factors in the use of B-PAS. In study IV, the different aspects of

	the redesigned clinical course were explored, through both quantitative and qualitative data collection.
5	Unequal sample sizes in the qualitative and quantitative data collection for studies I and IV were unavoidable. Since the different sample sizes can be considered both a strength and a limitation of each method, the differences are acknowledged. However, since the data collection is convergent, the unequal sample sizes can also be viewed as complementary and therefore a strength of the study design.
6	The convergent data analysis is the strength of this study design. In study I, the results were compared and viewed collectively; however, the convergent analysis process is not explicitly presented in paper 1, which challenges the validity of that study. In study IV, this step of the analysis is explicitly presented with a joint display.
7	The risk of failing to ask the correct questions when conducting convergent analyses or failing to identify disconfirming results is always a possibility. However, two researchers were involved in the process of analysing both sets of data in studies I and IV. Both complementary and discrepancies were discussed while the main results were categorized.

7 Conclusion

This complex mixed methods dissertation has contributed novel insights into the significance of confidence in performing B-PAS as an integrated component of overall nursing competence and fundamental nursing care. Furthermore, it comprehensively presents the Progression Model and explores its utility in enhancing students' confidence when using B-PAS, supported by the Suite of mLearning Tools. Collectively, these findings shed light on the interplay between students' confidence in performing B-PAS and their nursing competence as assessed through the NPC-SF – and its connection to fundamental care. Findings show that utilizing a mixed methods research design in educational research can be beneficial and is perhaps necessary to capture the complexity of teaching and learning.

The task of encouraging students to employ a systematic assessment approach like B-PAS and fostering nursing competence is a joint responsibility shared by the academic and clinical context. Academic teaching approaches and clinical supervision models must both actively nurture students' confidence and competence in performing B-PAS, as well as their cognitive abilities in applying clinical reasoning skills. Just as Nightingale (1860) emphasized the significance of patient observation skills as an integral component of the nursing profession, suggesting that those unable to master these fundamental skills should reconsider pursuing a nursing career. Today's students are fortunate to have the opportunity to cultivate and enhance B-PAS as a specific competence throughout their nursing education. In doing so, they can become confident and competent nurses who are prepared for practice in the complex healthcare landscape of the future.

Digital technology will undoubtedly be a part teaching and learning in higher education, as well as a part of continuous professional development. Consequently, learning with digital technology may therefore become more prominent in the future. The advantages of digital technology for learning should be explored to greater extent and thoughtfully integrated as a complementary approach to today's traditional pedagogical practices.

7.1 Suggestions for further research

The research presented in this dissertation raises new questions and sparks inspiration for further studies. The main directions for future research are suggested in the following text.

7.1.1 Research directions related to educational practices

While the Progression Model is well grounded in pedagogical principles of scaffolding and spaced repetition, refinement is needed. As Bandura (1977) explains, feedback is a powerful strategy for building students' confidence, representing an aspect of the model that can be developed further. This could involve exploration of what kind of feedback (e.g., formative, summative, or a combination) is best suited to building students' confidence. This could include testing out OSCE in combination with the new 'Confidence in performing B-PAS' questionnaire, which needs further validity testing to establish criterion validity. Future studies can also measure the impact of summative feedback on students' confidence and competence, as well as benefits of outlining areas of improvement. Formative feedback that bridges the students' performance of B-PAS between academic and clinical contexts, enabling assessment of their confidence and competence development, is another topic for future study.

Pedagogical practices regarding cognitive confidence in performing clinical reasoning is an area in nursing education that should receive additional focus. Sound clinical reasoning is critical for high-quality care and patient safety. The practical aspects of B-PAS are often the easiest to pay attention to and focus on to become more competent and confident. The cognitive aspects, by contrast, are often more complicated because of the implicit nature of those processes. It can be taken for granted that students use meta-reflections and intellectual processes like clinical reasoning when mapping patient clinical rotations. Meta-reflections and intellectual processes are often tacit knowledge. Therefore, practising to verbalizing these processes may contribute to more explicit and confident clinical reasoning processes. This dissertation research has revealed the value of virtual simulation and virtual patient for fostering clinical reasoning skills. However, the is a need

for stronger evidence regarding these learning processes and assessing the value of virtual patients. There are multiple research designs that would be appropriate to utilize in further studies of this, and multi-method or mixed methods approaches seem well suited, due to the complexity of teaching and learning. In the process of exploring confidence in performing B-PAS, the confidence items created for study III should be further validated in new groups and different contexts.

Further exploration of the usefulness of digital technology for students' learning is another area of importance, especially in response to government strategies and the needs of future students in higher education. It is also essential for faculty members to develop pedagogical and technological competence to utilize the affordances of technology in curriculum and course design.

Summarized research directions related to educational practices:

- test the implementation of OSCE and students' confidence in performing B-PAS in a randomized controlled trial in different contexts
- continue to explore the value of facilitation in virtual simulations for integrating professional knowledge and strengthening clinical reasoning skills
- strengthen the collaboration with clinical rotation placements and student supervision regarding the performance of B-PAS
- explore the focus areas for strengthening faculty members' digital competence in relation to e-pedagogy

7.1.2 Research directions related to the implementation of B-PAS in clinical practice

Teaching and learning in nursing education occurs in the academic and clinical contexts, and many factors contribute to the development of competence and confidence among nursing students during their nursing education. The key actors in nursing education – the faculty members, students, and supervising nurses – often experience a lack of coherence in what is taught in the academic context and what is practised in the clinical contexts. This is the situation regarding B-PAS.

There is therefore a need to collaborate closely with clinical practice and to support further implementation of B-PAS within fundamental nursing care among nurses. Even if the nurses in clinical practice choose not to use B-PAS, they should be encouraged to support students' development of confidence and competence in performing B-PAS.

It would also be interesting to focus more on nurses' practices and attitudes towards B-PAS by using both quantitative and qualitative methods in a mixed methods research design, and to look more closely into the differences (if any) between responses from nurses in community healthcare settings and nurses in hospital settings. The quantitative approach could involve the Barriers to Nurses' Use of Physical Assessment Scale, developed by Douglas et al. (2014); this would first need to be translated into Norwegian. The qualitative approach would be beneficial for deepening the data obtained from the questionnaire, as the participants would represent different healthcare settings.

In addition, it would be beneficial to explore the frequency of the use of B-PAS among nurses in clinical practice and to understand which skills are most used and in which healthcare setting. In particular, this should include an investigation as to whether the applications of these skills have an impact on patient outcomes in the different healthcare settings.

Summarized research directions related to clinical practice:

- explore nurses' attitudes towards B-PAS and which factors hinder or facilitate their use in clinical practice in a mixed methods research study; and investigate whether there are any differences in attitudes in hospitals or in community healthcare
- measure the frequency of the use of B-PAS among nurses in clinical practice and whether the use of these skills have an impact on patient outcomes

7.1.3 Research direction related to methodological issues of conducting mixed methods research

The advantages and value of conducting mixed methods study in nursing research should be highlighted within the profession. This dissertation has shown that using a

complex mixed methods research design has contributed to (a) developing novel insights into education in B-PAS, (b) how the Progression Model can contribute to the development of competence in nursing as well as confidence in performing B-PAS, and (c) how theoretical perspectives on nursing can be further developed to integrate this competence – not only as a technical skill, but as an integrated competence in person-centred nursing care in different clinical contexts. This would not have been possible with a single method study.

As using mixed methods research is an evolving methodological field that includes novel ways of integrating different mixed methods research designs and applying existing criteria to evaluate the validity of combined mixed methods research, this dissertation has also attempted to show how these criteria can be used in new, combined ways. Doing so may result in new and valid knowledge. Furthermore, there is also a need to further advance knowledge regarding research synthesis within complex mixed methods research designs and to investigate how knowledge creation can be expanded by using these kinds of methods. This calls for further methodological developments challenging researchers' creativity and methodological competence.

8 Implications for nursing education and clinical practice

Digital transformations influence pedagogical practices in higher education. Working towards quality in nursing education may include implementing new content for advancing students' competence and confidence in nursing. It may also involve using new teaching approaches to promote pedagogical strategies to meet future students' learning preferences. This dissertation's findings have implications for both nursing education and clinical practice. The main implications concern the importance of students' confidence for developing competence in nursing and person-centred fundamental nursing care, as well as the usefulness of the Suite of mLearning Tools and the Progression Model.

B-PAS will undoubtedly become more integrated into the nursing curriculum in Norway, as the fundamental nursing care literature[7] already includes theoretical knowledge related to these skills. Nurses in clinical practice strongly influence the professional development of nursing students, which is why students need to be supported in bridging the academic and clinical contexts. A supervision approach that values and highlights collaborative learning concerning B-PAS with students would be valuable for developing confidence and competence among nursing students.

B-PAS (both practical and cognitive aspects) should be included as part of nurses' continuous professional development, highlighting the necessity of strengthening the collaboration and formal partnership between the academic and clinical contexts. Formal courses for nurses' post-graduation are a way to support continuous professional development in nursing practice – and life-long learning processes. Utilizing the possibilities of mLearning to support continuous learning may be a solution for reinforcing competence development.

[7] Examples of Norwegian textbooks that include physical assessment: Grunnleggende sykepleie, Helsevurderinger og sykepleiedokumentasjon, and Klinisk Sykepleie.

Although B-PAS are essential skills to master in order to increase patient safety and quality of care, the cognitive aspects of B-PAS – i.e., clinical reasoning skills – are even more vital to master. One way to foster clinical reasoning is to learn how to use the hypothesis approach when working with B-PAS, as has been suggested in the literature (Lesa & Dixon, 2007; Lynaugh & Bates, 1974; Osborne et al., 2015): that is, to develop a hypothesis about what could be causing the changes in a patient's clinical situation. This approach relies heavily on all aspects of human bioscience knowledge. This is also an area on which the university and clinical practice could focus, to explore the most efficient way to support students' cognitive confidence concerning this approach. One of the mLearning resources – the virtual simulation with virtual patients – represents an innovative teaching tool that can enhance clinical reasoning and possibly the hypothesis-driven thinking processes. Nursing students should be supported to rely on and believe in their ability to provide high-quality, person-centred nursing care that is firmly rooted in professional knowledge.

The recent government report, 'Time to Act', challenges healthcare professionals to increase their collaboration, in order to develop more sustainable healthcare services by exploring the concept of task shifting (NOU:4, 2023). This call for action will certainly shape future healthcare services and encourage healthcare professionals to share and shift tasks, especially in the context of systematic patient assessment approaches such as B-PAS.

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Papers

Paper 1

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Revitalizing physical assessment in undergraduate nursing education - what skills are important to learn, and how are these skills applied during clinical rotation? A cohort study

H. Ösp Egilsdottir[1†], Kirsten Røland Byermoen[1*†], Anne Moen[1,2] and Hilde Eide[1]

Abstract

Background: The preparedness of newly graduated registered nurses for a demanding work environment and care practices takes form during nursing education. Norwegian nursing education at one university has implemented a selection of basic physical assessment skills (B-PAS) in the nursing curriculum in order to prepare nursing students for a demanding work environment post-graduation.

Methods: A mixed-method cohort design. We evaluated nursing students' self-reported use of B-PAS during their clinical rotation using the "Survey of Examination Techniques Performed by Nurses" questionnaire (30 items). In addition, two focus group interviews elicited factors that hinder or facilitate the actual use of B-PAS during clinical rotation. We recruited students from a bachelor's degree programme for nursing at a Norwegian university. Three hundred and sixty-three of 453 eligible nursing students in the first, second, and third year of the bachelor's degree programme participated in the study (80%).

Results: ANOVA showed a significant progression ($p < 0.016$) in students' self-reported use of B-PAS. Auscultation and percussion skills were graded below the median score of 3, which indicates that these skills were less used throughout the programme. The nursing students highlighted contextual factors for their use of B-PAS when in clinical rotation. Preceptors are important gatekeepers for successful implementation, and there is a need for close collaboration between the university and clinical practice.

Conclusion: Despite the reduced PAS taught in the curricula, there is still a lack of application of such skills in clinical rotations. This study highlights that research should explore how different work environments influence the utilisation of learned skills, and which learning strategies are appropriate or most successful for stimulating clinical reasoning and the extensive use of physical assessment.

Keywords: Physical assessment skill, Nursing students, Nursing education, Health assessment

* Correspondence: kirsten.roland.byermoen@usn.no
†H. Ösp Egilsdottir and Kirsten Røland Byermoen are Equal contributors as first authors
[1]Science Centre Health and Technology, Faculty of Health and Social Sciences, University of South-Eastern Norway, Grønland 58, 3045 Drammen, Norway
Full list of author information is available at the end of the article

Background

A rapidly changing work environment puts novice registered nurses' (RNs) abilities for clinical reasoning and clinical judgment to the test in all contexts. Adequate patient assessment in different clinical encounters can be challenging for newly graduated RNs because of increasingly complex healthcare needs, chronic disease, comorbidity, and polypharmacy [11, 20]. Novice RNs must master the ability to make decisions based on solid general health assessments and physical assessments; for example, by determining what data are important to collect and then choosing the right interventions in the correct order [15]. Several studies indicate that inexperienced RNs struggle to process large amounts of complex data, to anticipate changes in a patient's situation, and to differentiate between clinical situations that need immediate attention and those that are less acute [15, 16, 22]. This can threaten patient safety and could result in near misses and adverse patient outcomes [16, 22].

There is a general agreement that health assessment and physical assessment are core competencies within the scope of nursing practice [3, 19, 30, 32, 33]. The RNs' preparedness for demanding work environments and care practices takes form during the nursing degree programmes. Research has shown that it is important to articulate knowledge from human bioscience (anatomy, physiology, pathology, pathophysiology, and pharmacology) when assessing and interpreting the collected data [4, 18]. A persisting challenge is how the pedagogical methods and curriculum in nursing education influence and prepare nursing students for demanding clinical situations, especially regarding patient assessment and clinical reasoning [16].

Internationally, general health assessment and physical assessment are well-integrated in undergraduate nursing curricula, for example, in the US since the 1970s and in Canada, New Zealand, and Australia since the 1990s [1, 3, 5, 14, 17, 21]. However, a literature review and newer studies focusing on physical assessment in undergraduate nursing curricula show that newly graduated RNs are not using all of the physical assessment skills (PAS) they were taught in their clinical practice [3, 9, 21]. The RNs only use a subset of acquired PAS [2, 3, 21, 30]. This situation is not new and has been debated since Giddens [13] published her survey results focusing on the PAS that RNs use in their work. The highlights of the debate suggest that a critical review of the range of PAS taught in nursing education is necessary because these skills do not always reflect the RNs' or the nursing students' scope of practice [3, 9, 11, 13, 31]. More recent studies suggest, rather than reducing the number of PAS being taught, ensuring that the education programmes allow sufficient time on campus for the application and interpretation of patient assessment skills before and during the clinical rotation [3, 9, 33]. Perceived barriers for routinely adapting and implementing physical assessment in RNs' daily practice include doubts about the total impact on the patient outcome, a lack of confidence in performing physical assessments, and a lack of role models within the nursing profession [9].

Physical assessment in Norwegian nursing education

In Norway, the role of the nurse practitioner (NP) has recently been introduced in clinical practice, including the use of PAS. Following the implementation of PAS at the master's level, physical assessment was first documented in a bachelor's level curriculum in 2013 [4]. This means that there are few role models in clinical practice, and possibly little competent guidance for nursing students to apply these skills in direct patient care.

Fifty percent of Norwegian nursing education takes place in clinical rotation in different contexts [24]. In our University, seven clinical rotation periods are spread over three years. The nursing students are assigned preceptors in all clinical rotations and are supported by faculty. During the first year, the 8-week clinical rotation takes place in primary healthcare, in either home care or nursing homes. During the second year, the students have three clinical rotations – two at a hospital in the medical and surgical wards (8 weeks), and one related to health promotion (2 weeks). During the third year, the students are back in primary healthcare. One rotation takes place in home care, one rotation in nursing home care, and one in mental health care (all 8 weeks each).

In 2015, a carefully selected range of PAS was implemented in the curriculum in undergraduate nursing at our University. These included:

- the heart and peripheral circulatory system (11 skills)
- the respiratory system (7 skills)
- the abdominal system (6 skills)
- the neurological system (6 skills)

These PAS were considered to be the basic competence for bachelor's degree students, and are referred to as *basic* PAS (B-PAS) in the nursing curriculum at the university. There were three main reasons for the selection of these skills. First, other studies have shown that there is limited use of PAS in clinical practice [3, 9, 13, 30]. Second, the existing nursing curriculum was already saturated, and it was not possible to remove elements to make room for the full range of PAS. Third, the newly started master's programme for NPs also included a physical assessment course with a broader focus. Therefore, it was important to establish an understanding of the differences in scope of practice between the RN level and the NP level.

We developed a progression model to scaffold students' B-PAS development throughout their nursing education (Fig. 1).

Figure 1 illustrates the relationship between and the progression in developing B-PAS and educational courses in clinical rotation throughout the nursing programme.

Method

The aim of this study was to evaluate nursing students' self-reported use of B-PAS in clinical rotation after implementation of this component in their nursing education. We also sought to identify factors that inhibit or encourage the nursing students in the use of B-PAS and how these factors can influence the students' development of competence and confidence in applying these skills. The study had a mixed-method cohort design, collecting data using self-reporting survey questionnaires and focus group interviews. The focus group interviews enabled the researchers to focus on specific elements in the questionnaire. By using mixed methods, the results from the different data sources can complement and strengthen each other [28, 29].

Data collection

During spring 2017, all first-year students (cohort 2016) and second-year students (cohort 2015) at our campus were invited to participate in the survey and in one focus group interview. The third-year students that year were not included in the current study because they were only introduced to B-PAS during the last year of their studies. The included students had all been taught B-PAS from their first year of study. Cohort 2015 was also invited to answer the questionnaire at the end of their third year, during spring 2018.

All of the students had finished their clinical rotation in the educational year in which the data collection was carried out. An invitation with information was published on the University's web-based learning platform. The researchers then met the students to provide additional information about the study when handing out a paper-based questionnaire after lectures on campus. Participants in the focus group interviews volunteered directly to the researchers, at which time additional information was provided. Table 1 gives an overview of the design, student cohorts, data collection time, and measures.

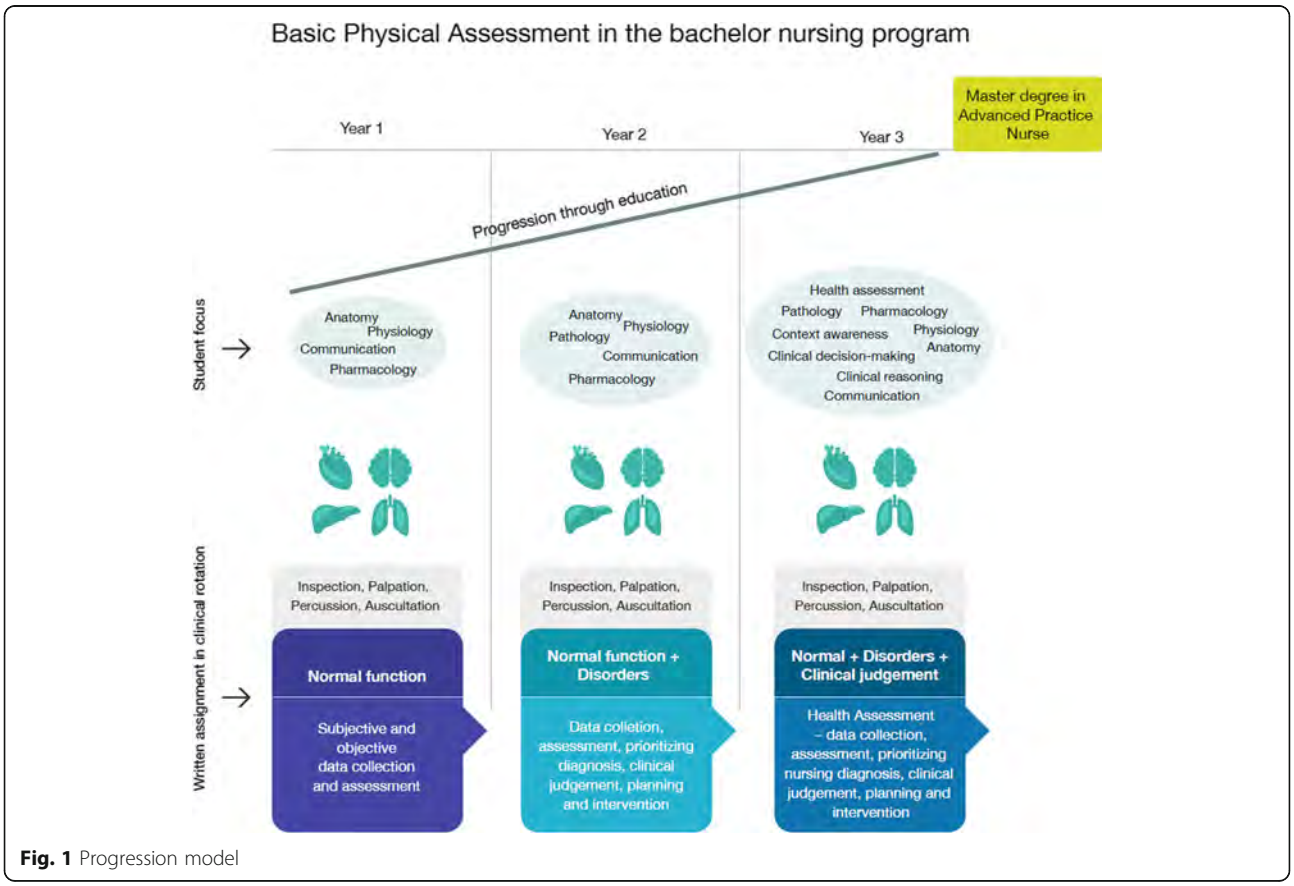

Fig. 1 Progression model

Table 1 Overview of design, student cohorts and data collection time

	Spring 2017		Spring 2018
	Questionnaire	Focus group interview	Questionnaire
Student cohort 2015 Started autumn 2015 in the nursing programme	x	x	x
Student cohort 2016 Started autumn 2016 in nursing programme	x	x	

Use of B-PAS was surveyed with 30 items selected from the "Survey of Examination Techniques Performed by Nurses" developed by Jean Giddens in 2007. The original validated instrument contains 122 physical assessment items. Modification of the original instrument was necessary due to the focus on B-PAS, and our questionnaire measures the taught skills.

The questions asked about the extent to which the students use the different elements in physical assessment with a Likert scale of six possible answer categories: (1) *I do not know how to do this technique*, (2) *I know how to do this technique, but have never done this in my clinical practice*, (3) *I perform this technique rarely*, (4) *I perform this technique occasionally*, (5) *I perform this technique frequently in my clinical practice*, and (6) *I perform this technique regularly in my clinical practice*. Participants were asked to rate the frequency with which they performed each skill in the clinical setting. Approval to use and restructure the questionnaire was given by Giddens in January 2017.

Five background variables were also collected, including year of nursing school, gender, age, healthcare-related work or other work-related experiences prior to entering nursing education, and the number of paid working hours while attending nursing school.

From our experience as faculty working with nursing students in clinical rotation and the collaboration between nursing students and preceptors, elements in the Norwegian context were identified that could influence the use of B-PAS in clinical rotation. The students were asked: "Which of following factors will increase the use of basic physical assessment skills in clinical rotation?" with the following six possible answers: (1) *Collaboration with fellow students*, (2) *More collaboration with the preceptor during clinical rotation*, (3) *More facilitation from faculty*, (4) *Instruction videos*, (5) *An online course*, or (6) *None of the mentioned choices*. The students marked the factors they agreed would support the use of B-PAS. They could mark as many factors as they wished.

To acquire a deeper understanding of the results from the questionnaire, two focus group interviews were conducted after the students answered the questionnaire, one with first-year nursing students (cohort 2016) ($n = 6$, duration 45 min) and one with second-year students (cohort 2015) ($n = 7$, duration 55 min). The interviews were semi-structured with open-ended questions. The questions focused on a) the general use of B-PAS, b) the contextual factors that encouraged or hindered these assessment skills being used in clinical rotation, and c) the factors that would increase the learning outcome when developing and applying the skills. The nursing students spoke freely about their own experiences and reflected on their time in clinical rotation. The researchers stimulated the students to talk together without influencing their reflections [10]. During the interviews, the researchers used follow-up questions if there were unclear statements that required elaboration.

Research ethics

The Norwegian Centre for Research Data (NSD) approved the study (Project No. 53525). All students were informed about confidentiality and voluntary participation. The study information and invitations to participate in the study were introduced in writing through the school's learning management platform. Written information included the aim of the study and how data would be collected by using self-reported questionnaires and focus group interviews. The researchers also gave oral information in the classroom when there was an opportunity to do so.

Data analysis

Descriptive statistics were used to analyse demographic and B-PAS data in the questionnaires (SPSS 24 Inc., 2017). The B-PAS data used a Likert scale for calculation of mean and frequency and median scores to measure central tendency. To allow comparison with similar studies [3, 13, 19], the mean and standard deviation are presented for more insight and understanding. One-way between-group analysis of variance of independent groups (ANOVA) was conducted to explore the development in the use of B-PAS between all three cohorts as follows: development between the first and second year, between the second and third year, and between the first and third year. Due to multiple comparisons, the p value was set to 0.016 using Bonferroni correction. We also calculated effect sizes (Cohen's d) to evaluate degree of change, which was categorized as small (< 0.5), medium (0.5–0.8), or large (> 0.8) [6].

The focus group interviews were analysed using content analysis, drawing from Elo and Kyngäs [10]. The interviews were transcribed verbatim and read thoroughly to acquire an overview of how the students elaborated on their experiences in clinical rotation [10]. Combing our focus on B-PAS and students' experiences, central

themes were identified, further abstracted as subcategories, and then presented as main categories [10].

Results

The results of the questionnaire highlight the B-PAS used in clinical rotation by the nursing students, as well the progression between the educational years, while the results from the focus group interviews highlighted the contextual factors in the work environment in the clinical rotations.

Of the 453 students who were invited to participate, 363 returned the survey questionnaire fully completed (an overall response rate of 80%). By class cohort, the response rates were as follows: first year (cohort 2016), 146 of 184 (79.4%); second year (cohort 2015), 127 of 142 (89.4%); and third year (cohort 2015), 90 of 127 (70.9%).

Consistent with the university's overall demographic data profile, the sample consisted primarily of women (84.6%, $n = 307$) with a mean age of 25.3 years. About half (50.4%, $n = 183$) had no experience in healthcare before starting the Bachelor's programme, 24.2% ($n = 88$) had 1–2 years of experience, 16.8% ($n = 61$) had 3–5 years of experience, and 8.6% ($n = 31$) had more than 6 years of experience. The majority of the students (56.2%, $n = 205$) worked about 1 to 2 shifts weekly (7.5 to 15 h) during nursing school, while 29.2% ($n = 106$) did not work any extra hours in healthcare services during nursing school.

The focus groups consisted of 13 participants – six men and seven women – ranging in age from 23 to 49 years.

Survey findings

The students self-reported their knowledge and use of the 30 different PAS on a Likert scale of 1–6. Seven skills had a median score of 4 or higher in all cohorts, indicating that the students used the skills "occasionally to regularly" during clinical rotation. Altogether 13 skills were scored with a median score of 4 or higher throughout all three years. Thirteen skills had a median score of 3 for all cohorts, which indicates rarely using these skills.

ANOVA of the mean scores showed that all respondents knew how to perform the different types of physical assessment. However, Table 2 shows that there was some variation in how often students reported using the skills. The main progression in use of B-PAS was between the first and third year, and Table 2 shows that the mean difference was statistically significant at $p < 0.016$ in 19 of the 30 implemented skills. The actual difference in mean and median scores between the groups was small; however, there was a change and development in the student's use of B-PAS as indicated by Cohen's d with 17 of the total 30 skills having medium to large effect sizes. No demographic data reached statistical significance in correlation analysis of the usage of B-PAS.

Assessments of neurology, percussion, and auscultation in abdominal, respiratory and circulatory systems had median scores of 3 and were thus seldom used. Table 3 illustrates the four skills that had a median score of 1 or 2.

In the B-PAS for assessing the heart and peripheral circulatory system, six of eleven skills changed significantly. Four of the skills had a medium effect size, and one skill, palpate capillary refill, had a large effect size. In the B-PAS for assessing the respiratory system, six of seven skills changed significantly over the three years. Three skills – measuring the respiration rate, assessing SpO_2, and inspecting the thorax – had a large effect size. Auscultation of the lungs did not reach statistical significance despite a medium effect in development over time. In the B-PAS for assessing the abdominal system, five of six skills had statistically significant development and, of these, four had a medium effect size and one, light abdominal palpation, had a large effect size. In the B-PAS for assessing the neurological system, two of five skills reached statistical significance, and the skill of evaluating sensation of touch had a medium effect and evaluating mental status had a large effect in use.

In the questionnaire, the nursing students were asked to indicate which factors might support increased use of B-PAS in their clinical rotation. The three most important factors were collaboration with fellow students, increased collaboration with preceptors in clinical rotation, and greater facilitation from faculty. Table 4 presents the students' answers in prioritized order.

Focus group findings

The focus group interviews broadened the understanding of the questionnaire results presented in Tables 2, 3 and 4. The interviews also gave insight into how nursing students experienced applying B-PAS skills and which challenges they met during clinical rotation. Table 5 presents the three main categories that were identified from the focus groups interviews.

Category 1 "Taking vital signs and being responsible for NEWS score are a routine student assessment, but doing more is challenging": In the interviews, the nursing students talked about which tasks were quickly assigned to them at the beginning of the clinical rotations. Taking vital signs and being responsible for scoring the early warning score (EWS) (in Norway, National Early Warning Score, NEWS) was a routine student assignment in the clinical rotation. A second-year student said:

> "*It's like, especially related to NEWS-ing or assessing, the pulse, the respiration rate*".

Table 2 Development of basic physical assessment skills over the 3-year nursing programme

Physical assessment skills	Mean (*SD*), Median			Cohen's *d* effect size	
	1st year	2nd year	3rd year	1–2 year	1–3 year
Heart and peripheral circulation					
Inspect extremities for skin colour/hair growth	4.51 (1.17), 5	5.13 (3.69), 5	4.73 (1.05), 5	0.22	0.19
Palpate distal pulses	3.62 (0.96), 4	4.28 (1.12), 4	4.22 (1.07), 4	0.63*	0.59*
Count pulses [a,b]	4.23 (2.57), 4	5.14 (0.80), 5	4.99 (0.87), 5	0.48	0.39
Palpate for oedema [a,b]	3.65 (1.16), 4	4.20 (1.06), 4	4.38 (0.99), 4	0.50*	0.67*
Palpate and inspect capillary refill [a,b]	2.78 (1.21), 3	3.76 (1.21), 4	3.77 (1.11), 4	0.80*	0.85*
Estimate skin fold [a,b]	2.86 (0.94), 3	3.30 (1.08), 3	3.56 (0.91), 4	0.43	0.75*
Evaluate extremities for skin sensation [a,b]	2.30 (1.10), 2	3.10 (1.15), 3	2.92 (0.87), 3	0.71*	0.62*
Assess fine motor skills	2.62 (1.27), 2	2.98 (1.23), 3	2.98 (0.96), 3	0.28	0.31
Take blood pressure [b,c]	3.91 (1.04), 4	3.61 (1.09), 4	4.29 (1.09), 4	-0.28	0.35
Auscultate heart sounds	2.52 (1.02), 2	2.32 (1.01), 2	2.57 (0.88), 2	-0.19	0.05
Auscultate carotid artery	2.60 (0.91), 2	2.52 (1.16), 2	2.76 (0.97), 3	-0.07	0.17
Thorax					
Inspect thorax for shape, breathing effort [a,b]	3.55 (1.16), 4	4.45 (1.25), 5	4.31 (1.06), 4	0.74*	0.68*
Count respiratory rate [a,b,c]	3.99 (0.91), 3	5.57 (0.65), 6	5.09 (0.87), 5	1.99*	1.23*
Inspect thorax for skin colour/scar [a,b]	4.28 (1.22), 4	5.13 (0.83), 5	5.97 (0.77), 5	0.83*	1.63*
Palpate thorax wall for thoracic expansion and vocal fremitus [a,b]	2.82 (1.03), 3	3.41 (1.34), 3	3.27 (1.07), 3	0.50*	0.42
Percuss the lungs [b]	2.41 (0.79), 2	2.52 (1.02), 2	2.87 (0.93), 3	0.12	0.53*
Auscultate lungs	2.70 (0.86), 3	2.76 (1.02), 3	3.13 (0.99), 3	0.06	0.46
Assess SpO_2 [a,b]	3.83 (1.31), 4	5.63 (0.66), 6	5.03 (1.02), 5	1.73*	1.02*
Abdomen					
Inspect abdomen [a,b]	2.95 (1.21), 3	3.87 (1.06), 4	3.74 (1.07), 4	0.80*	0.69*
Auscultate abdomen for bowel sounds [b]	2.61 (0.86), 2,5	2.90 (1.06), 3	3.02 (0.92), 3	0.30	0.46
Light abdominal palpation [a,b]	2.62 (0.89), 3	3.13 (1.05), 3	3.36 (0.90), 3	0.52*	0.82*
Deep abdominal palpation	2.21 (0.78), 2	2.65 (1.00), 2	2.70 (0.90), 3	0.49	0.58*
Percuss the abdomen [b]	2.36 (0.79), 2	2.52 (0.99), 2	2.77 (0.81), 3	0.17	0.51*
Percuss for kidney tenderness [a,b]	2.05 (0.84), 2	2.41 (0.97), 2	2.57 (0.81), 2	0.39	0.63*
Neurology					
Evaluate CN I-XII	1.82 (0.88), 2	1.88 (1.73), 1	2.20 (1.09), 2	0.04	0.38
Evaluate muscle strength, atrophy, tone	2.63 (1.13), 2	2.73 (1.26), 3	2.79 (1.06), 3	0.08	0.14
Evaluate sensation of touch [a,b]	2.28 (1.12), 2	2.89 (1.2), 3	2.96 (0.91), 3	0.52*	0.66*
Assess coordination and balance	3.16 (1.13), 3	3.43 (1.46), 3	3.32 (1.23), 3	0.20	0.13
Evaluate patella and plantar reflexes	2.25 (0.67), 2	2.36 (0.77), 2	2.47 (0.80), 2	0.15	0.29

[a]mean difference is significant at the 0.016 level between 1st - 2nd year
[b]mean difference is significant at the 0.016 level between 1st - 3rd year
[c]mean difference is significant at the 0.016 level between 2nd - 3rd year
*Cohen's *d* effect size above 0.5

Table 3 Basic physical assessment skills with median scores 1 and 2 in all cohorts

Auscultate heart sounds
Percuss for kidney tenderness
Evaluate CN I-XII
Evaluate patella and plantar reflexes

A first-year student also said:

"It depends on what patients you meet, but there was a lot of checking for pulse and blood pressure and oxygen saturation".

At the same time, the students mentioned that because taking vital signs and "NEWS-ing" the patient data was

Table 4 What will increase the use of basic physical assessment skills in clinical rotation? ($N = 363$)

Cooperation with fellow students	67, 9% ($n = 210$)
More cooperation with nurse in clinical rotation	57, 3% ($n = 208$)
More facilitation from preceptor	42, 7% ($n = 155$)
Instruction videos	28, 9% ($n = 105$)
Online course	23,1% ($n = 84$)
None of the mentioned choices	5,2% ($n = 19$)

so implemented as a student assignment, it provided a good opportunity to expand the assessment and use B-PAS to a certain extent:

> *"Doing NEWS is very well implemented here* (in the hospital setting), *that you could combine these two* (the B-PAS and NEWS), *let's say that you are taking the blood pressure then you could also assess the peripheral circulation, like pulses and oedema right? If you combine these two* (the B-PAS and NEWS) *you all of a sudden have more information to make a better assessment (second-year student)".*

The students also felt that opportunities to apply B-PAS in clinical rotation were dependent on the preceptor's personal attitude towards the relevance of these new skills. If the preceptors welcomed B-PAS in their work methods, the students were encouraged to apply and practice the skills in direct patient care. However, if the preceptors expressed a negative attitude towards B-PAS, the students struggled to find opportunities to use these skills:

> "*One of our preceptors had been attending a course here* (at the university) *and she was probably not a fan of B-PAS, so she thought it was, I don't know, a little inconvenient that it took too much time, and that the first assessment was too extensive to make (second-year student)".*

A first-year student highlighted this:

> *"Luckily we were two students* (at the clinical rotation) *and it was really good to be two students. We were able to talk because we both knew what we were supposed be doing, and it was difficult to get an understanding about that from the staff on the unit, they didn't stand in our way or ruin anything for us, but they* (the staff) *didn't want to, didn't understand what we were supposed to be doing there".*

Some of the students also experienced that the preceptor commented directly that doing B-PAS was a physician's work, not a nurse's. This indicates that the students struggled to get support and encouragement to apply B-PAS in clinical rotation. Despite a lack of support, the students found it meaningful to try to apply some of the simpler B-PAS skills, like vital signs which are well-known nursing tasks.

Category 2 "Skill development in clinical practice can be fostered by access to digital learning resources when in clinical rotation": In the nursing students' opinion, it would have been helpful and supportive to have access to digital learning resources demonstrating B-PAS when in clinical rotation. This would give guidance related to questions or challenges that the students encountered and would support working with the basic physical assessments in clinical rotation. To quote one of the second-year students:

> *"As a nursing student you really want to have the apps, because you feel supported if you can go in and get the information, it's easier. If you have an app which was a collection of all the knowledge about these issues, with some instruction videos which you could watch and refresh the skills and B-PAS techniques, and then apply these in clinical rotation. Then it would be easier and more useable to apply it because you have doubts about whether what you are doing is according to standards".*

In addition, the students wondered how available the knowledge related to B-PAS was for the preceptors; in terms of educating the preceptors and for the students to be able to show them what B-PAS was really about. However, the students valued the opportunity to practice with peer students and develop the skills at a university skill lab with faculty. One of the first-year students said:

> "*It would have been nice, like at least before we were going into clinical rotation, if it had been possible to practice more. That is something I would have appreciated, because it's just about having it* (B-PAS) *in your fingers*".

Another first-year student followed up and stated that:

> *"It would be good to practice now, after we have been in the clinical rotation and practiced properly, now we know more about what we need to practice on".*

Table 5 The main categories for the focus group interviews

1. Taking vital signs and being responsible for NEWS score are routine student assessments but doing more is challenging
2. Skill development in clinical practice can be fostered by access to digital learning resources when in clinical rotation
3. A culture for articulation of knowledge fundamental for clinical reasoning, clinical judgement, and self-efficacy in B-PAS

Still, the students also stated clearly that it would increase the learning outcomes in terms of skills development and proficiency to apply B-PAS in direct patient care. As one of the second-year students highlighted:

> "*I'm thinking, it's really good to work with a nurse or a physician, to inspect, palpate, practice, it was helpful that we did it in the simulation lab before clinical rotation, just to actually understand what this is about. But, it is different when you meet a sick patient and have to relate to what it is that you do, or what you are looking for. One thing is doing this on healthy persons* (fellow students) *but another is doing it on sick patients, when you have to try to understand why and how things are related".*

It is clear that the nursing students' learning experiences and opportunity to develop B-PAS depends both on being able to practice at the university with faculty as well as in the clinical context with preceptors.

Category 3 "A culture for articulation of knowledge fundamental for clinical reasoning, clinical judgement, and self-efficacy in B-PAS": The nursing students also pointed out the need to focus constantly on the fundamental knowledge required to perform B-PAS. This fundamental knowledge includes anatomy and physiology, which explains the healthy body and body sounds. As well as pathophysiology and pathology, which explains the sick body. One of the second-year students highlighted this:

> "*When you do not get a bit of it* (the knowledge in human science courses) *linked to practicing* (B-PAS), *I think it* (the knowledge in human science courses) *will be disconnected, and I have to try really hard to link these things* (the knowledge and the skills) *together on my own".*

Another second-year student elaborated further:

> "*It's hard to get things to connect together because...maybe one should have anatomy and pathophysiology…a bit like continuously together for example with the heart, to learn about the healthy heart first and then learn about the sick heart".*

Some of the students experienced valuable feedback from physicians which fosters the knowledge transition between fundamental knowledge and developing B-PAS. Both preceptors and physicians were regarded as important discussion partners on how to interpret the data collected via B-PAS. They supported discussions about the collected "cues" in the nursing assessment that promote clinical reasoning. The nursing students also emphasized that using B-PAS would contribute to better communication and collaboration between the nurses and physicians:

> "*I had quite a lot of collaboration with the doctor and I think that the doctor assumed that I was a third-year student because she used very many medical terms (first-year student)*".

A "safe" environment was necessary to feel comfortable enough to ask questions and to discuss observations with both nurses and physicians after performing B-PAS, especially regarding the meaning and interpretation of possible findings. One of the second-year students said:

> "*We made our own assessments. Then I went back to the doctor and my preceptor to discuss what we had seen, and in many cases, it matched. Then you get that feeling that this is something you can master and that you can become a good nurse*".

Further emphasizing the importance of good communication, one second-year student said:

> "*To have someone to discuss things with, who does not think that you are asking stupid questions. That this is useful learning and that we sit here and discuss it, that you dare to test out these skills and that you dare to say what you think, that you can accept receiving feedback for how you can become better and such things. That is how you become more confident*".

These statements indicate that the cultural factors in the work environment influence students' learning and knowledge transitions. Thus, good communication and collaboration between nurses and physicians in the clinical rotation units are essential for the nursing student to develop clinical reasoning and develop B-PAS.

Discussion

The current study reports the findings from the first evaluation of the implementation of a selection of B-PAS in a Norwegian bachelor's level nursing programme. We contribute to the discussion of what skills should be taught, how the skills are taught over time, and to the call for close collaboration between the university faculty and preceptors in clinical rotation. The main findings are that despite reducing the comprehensive PAS in the curriculum and focusing on a set of B-PAS, utilisation of the skills in clinical practice is still limited. These findings are interesting in the light of research that argues for the benefits of reducing the range of skills that are taught in nursing education [3, 8, 13, 14, 30].

Although the nursing students in the study did not use the full range of B-PAS, the results show an overall

increase in the use of the skills over the 3-year nursing education. The median scores as seen in Table 2 indicate that the nursing students in general practice more of every skill throughout their education. B-PAS that include assessing vital signs are frequently used in both the second and third year. Assessing respiratory rate and assessing SpO_2 (which is also part of the vital signs assessment) increased by more than 1.0 in median score from the first to third year. This is a positive progression regarding the use of EWS and the quick-SOFA criteria (early identification of sepsis) which is similar to results from other studies [26, 32]. Assessing vital signs is an important skill because research shows that changes in vital signs (for example, respiration rate, pulse, and blood pressure) are predictors for clinical deterioration [12, 25]. Osborne et al. [26] stress that it is important to take into account factors such as comorbidity, advanced aging and frailty, polypharmacy, and fluid-electrolyte balance when assessing vital signs. Assessing vital signs is a part of B-PAS; it is important to combine the skills applied with clinical reasoning based on human biosciences in all clinical rotations throughout nursing education. By discussing and interpreting the collected data, nursing students will be able to articulate their decision-making processes and nursing practice to a greater extent [7, 18]. By understanding this, the preceptors can be key persons in supporting the nursing students to articulate knowledge from their studies on human biosciences, and in influencing the development of clinical judgement.

One might assume that practicing the same set of B-PAS every year would facilitate a greater progression between the first-year and the third-year students. However, it is not enough to practice B-PAS only in the university skills lab, and the nursing students themselves highlight the importance of practicing these skills in direct patient care. If the students do not practice B-PAS in clinical rotation, they are not likely to gain the confidence to practice them later. As shown in earlier studies, knowledge and competence without confidence will likely lead to PAS not being applied in clinical work [11, 21].

All students reported a median score below 4 in all the skills that included *percussion* and *auscultation*, meaning that they used these skills to a small extent or did not know how to perform them. These findings are similar to other study results [3, 13, 14, 30].

The varied utilisation of B-PAS indicates that contextual factors might have a greater impact on usage of B-PAS than anticipated, which is supported by the results from the focus group interviews. The fact that the nursing students do not have the confidence or opportunity to apply all of the B-PAS does not necessarily indicate that changes must be made regarding the skills taught in the education programme. As pointed out by others, this might rather indicate that the work environment and preceptor's choice of methods have a greater and more complex influence on the processes related to the utilisation of B-PAS [8, 9, 23].

The nursing students practice B-PAS in a work environment that does not yet have a culture for, or supports, these types of nursing skills. The focus group interviews highlighted these perspectives, suggesting that the nursing students have to rely on their own motivation to develop and apply B-PAS rather than on guidance from their preceptors. This can also indicate that the focus for the students is on proficiencies, not on articulating knowledge, discussing cues and findings, or developing clinical reasoning skills. The challenging work environment for the nursing students in this study might have influenced the anticipated progression in the use of B-PAS.

Through the focus group interviews, the students explained that negative attitudes or critical comments from their preceptor or other healthcare workers could hinder their use of B-PAS and thus present a challenge to autonomous nursing work. Good examples of this are B-PAS that the students viewed as technically difficult, such as *percussion* and *auscultation* skills, as well as the skills related to *neurological assessment*. In practice, the students cannot rely on the preceptor's guidance because the preceptor does not have B-PAS in their nursing education or as part of their current repertoire. Values and culture can be a barrier for successful implementation and can be a source of tension or conflict between those nurses who do not have these skills and, as in our study, the nursing students who need to learn these skills [8, 23]. The tension in the Norwegian context might explain why the nursing students in this study are reluctant to use B-PAS in their clinical rotations. When asked, more than half of the students believed that greater collaboration with preceptors would increase their learning outcomes related to the use of B-PAS. This also emphasises that the university must work more strategically with the preceptors in clinical practice. This includes offering clinical courses in B-PAS for the preceptors to increase their understanding of what the students learn in undergraduate education, as well as how to facilitate learning processes related to PAS. By organising training courses for preceptors, they could better support the students in utilising B-PAS when in clinical rotation.

The expectation is that with time, the impact of inhibitory factors in the work environment in the Norwegian context will be reduced as B-PAS become better known, and there are more examples of how they can positively influence nursing practice. Despite the reduced number of PAS in the curriculum, the results presented here are still similar to those of international studies where a small set of skills was used. This illustrates how important it is to discuss what skills should be taught in a bachelor's programme, how the skills are taught, and the

need for close collaboration with preceptors in clinical rotation [9].

Limitations and strengths of the study

This cohort study used a single campus site for data collection in the Norwegian context. A strength of the study is the overall good response rate to the questionnaire. Due to the recent implementation of B-PAS, it was necessary to elicit student experiences with these curricular elements. This is a first endeavour to evaluate the programme and identify possible needs for change and modification before further deployment at other campuses. One limitation of the study design was not having all three cohorts, but we deemed it unfeasible to wait until we had a baseline for three different cohorts. Despite the limitations, our results show a strong similarity to the findings from other studies [3, 13, 14, 30]. We included a smaller group of participants in the focus group interviews, and the results must be interpreted with some caution. However, as the first study in Norway, the focus group interviews contributed to a better understanding of the challenges nursing students experienced when applying these skills in clinical rotation, especially in terms of factors that might hinder or facilitate further learning.

Conclusion

Despite reduced PAS being taught in the curriculum, there is still a lack of use of B-PAS in clinical rotations. Even though B-PAS are not fully used, the results do indicate that they are increasingly used in clinical rotation throughout the 3-year nursing programme. This paper highlights that further studies are needed, both in a Norwegian and international context, in order to explore how the learning environment and preceptors' attitudes influence the nursing students' utilisation of B-PAS in combination with vital sign assessment. By discussing possible findings, the preceptors can promote nursing students' articulation of knowledge from their studies on human biosciences, and they can influence the development of clinical judgement. It is important to assess whether the selected B-PAS are appropriate to teach in the 3-year undergraduate nursing curricula, and to continue to map the use of these skills in clinical practice. The study indicates that the nursing students are selective in what skills they apply in daily practice, but it remains essential that they apply B-PAS in a skills lab (a safe environment) and during clinical rotation in different contexts. This can positively change their ability to utilise their skills, and to develop competence and confidence as well as clinical judgement. It is important to explore different types of on-campus learning methods related to PAS. In addition, it will be important to further explore how clinical virtual simulation and reflection can stimulate critical thinking related to the development of clinical judgement [27].

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Authors' contributions

H. Ösp Egilsdottir (HÖE), Kirsten Røland Byermoen (KRB), Anne Moen (AM) and Hilde Eide (HE). HÖE and KRB are both first authors with equal substantial contribution to conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article and revising it critically for important intellectual content. HE and AM have contributed to the design of the study, analysis and interpretation of data, drafting the article and revising it critically for important intellectual content. All authors have read and approved the final manuscript.

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Availability of data and materials

The quantitative datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The Norwegian Centre for Research Data (NSD) approved the study (Project No. 53525). The participants in this study received oral and written information about confidentiality and voluntary participation. The participant gave written consent by filling out the questionnaires and provided written consent prior to the focus group interviews.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Science Centre Health and Technology, Faculty of Health and Social Sciences, University of South-Eastern Norway, Grønland 58, 3045 Drammen, Norway. [2]Institute for Health and Society, Faculty of Medicine, University of Oslo, Kirkeveien 166, Fredrik Holsts hus, 0450 Oslo, Norway.

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Publisher's Note

Paper 2

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Original Paper

Configuration of Mobile Learning Tools to Support Basic Physical Assessment in Nursing Education: Longitudinal Participatory Design Approach

H Ösp Egilsdottir[1], MSN; Lena Günterberg Heyn[1], PhD; Espen Andreas Brembo[1], PhD; Kirsten Røland Byermoen[1], MSN; Anne Moen[2], Dr Polit; Hilde Eide[1], Dr Philos

[1]Science Centre Health and Technology, Faculty of Health and Social Sciences, University of South-Eastern Norway, Drammen, Norway
[2]Institute for Health and Society, Faculty of Medicine, University of Oslo, Oslo, Norway

Corresponding Author:
H Ösp Egilsdottir, MSN
Science Centre Health and Technology
Faculty of Health and Social Sciences
University of South-Eastern Norway
Grønland 58
Drammen, 3045
Norway
Phone: 47 94886406
Email: osp.egilsdottir@usn.no

Abstract

Background: As many students in higher education are skilled users of mobile technology, mobile learning (mLearning) can be a promising educational strategy to enhance their learning experience. mLearning might also be well suited for nursing students as they navigate between multiple learning contexts in their educational curriculum. As an educational strategy, mLearning may also reduce challenges caused by the theory-practice gap in nursing by supporting skills and knowledge transfer between the university and clinical settings. As the introduction of basic physical assessment skills (B-PASs) into Norwegian bachelor's degree education in nursing occurred quite recently, there is a lack of competence in supervision and teaching in both university and clinical settings. As such, mLearning appears to be a good strategy to support student B-PAS learning and knowledge transfer across learning contexts.

Objective: This study aims to explore and elicit the perspectives of students regarding the way in which a selection of digital learning resources supports B-PAS learning and application in clinical rotation, which of the selected digital learning resources are beneficial to include in a suite of mLearning tools, and how the selected digital learning resources could support the transfer of skills and knowledge from the academic to clinical context.

Methods: We used a longitudinal participatory design approach to co-design a suite of mLearning tools. The co-design processes took place in several workshops (WSs) over a period of 3 months: 2 WSs with first-year students (n=6), 3 WSs with second-year students (n=6), and 3 WSs with third-year students (n=8). The students evaluated several digital learning resources in both academic and clinical contexts. The digital learning resources included digital simulation with virtual patients, massive open online courses, and multimedia learning material. In the co-design WS, the potential and benefits of these digital learning resources for the learning and application of B-PASs were explored.

Results: The students reported that the digital learning resources stimulated learning in 7 different ways. They also emphasized the importance of including all selected and tested digital learning resources. Moreover, students supported the inclusion of additional learning material, such as multiple-choice tests and written assignments, aimed at providing feedback and contributing to knowledge development.

Conclusions: The co-design processes and collaboration with the nursing students provided insight into how a suite of mLearning tools may support the learning and application of B-PASs and human bioscience knowledge in clinical rotation. From the students' perspective, one of the strengths of the suite of mLearning tools was the range of content, as this met a broader range of student learning preferences regarding learning B-PASs. The suite of mLearning tools contributes to and supports skills training and knowledge transfer between multiple learning contexts.

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KEYWORDS

learning; mobile phone; mobile application; education, nursing; students, nursing; education, clinical; nursing skills; physical examination; computer simulation; clinical competence

Introduction

Mobile Learning Opportunities in Higher Education

Students pursuing higher education today expect teaching methods that stimulate self-directed learning, active learning, peer learning, and the cocreation of knowledge [1,2]. Many of these students belong to the *digital natives* generation having grown up with mobile technology such as smartphones; this makes them skilled users, especially with regard to social interaction and finding information on the web [2,3]. Mobile technology used for mediating educational content offers flexibility in teaching methods; thus, mobile learning (mLearning) promotes and contributes to learning processes that are less constrained by time and context [4-6]. Research indicates that mLearning contributes to meaningful and comprehensive learning experiences, inviting students to select their preferred modalities and share the responsibility for their own learning processes [1,7,8].

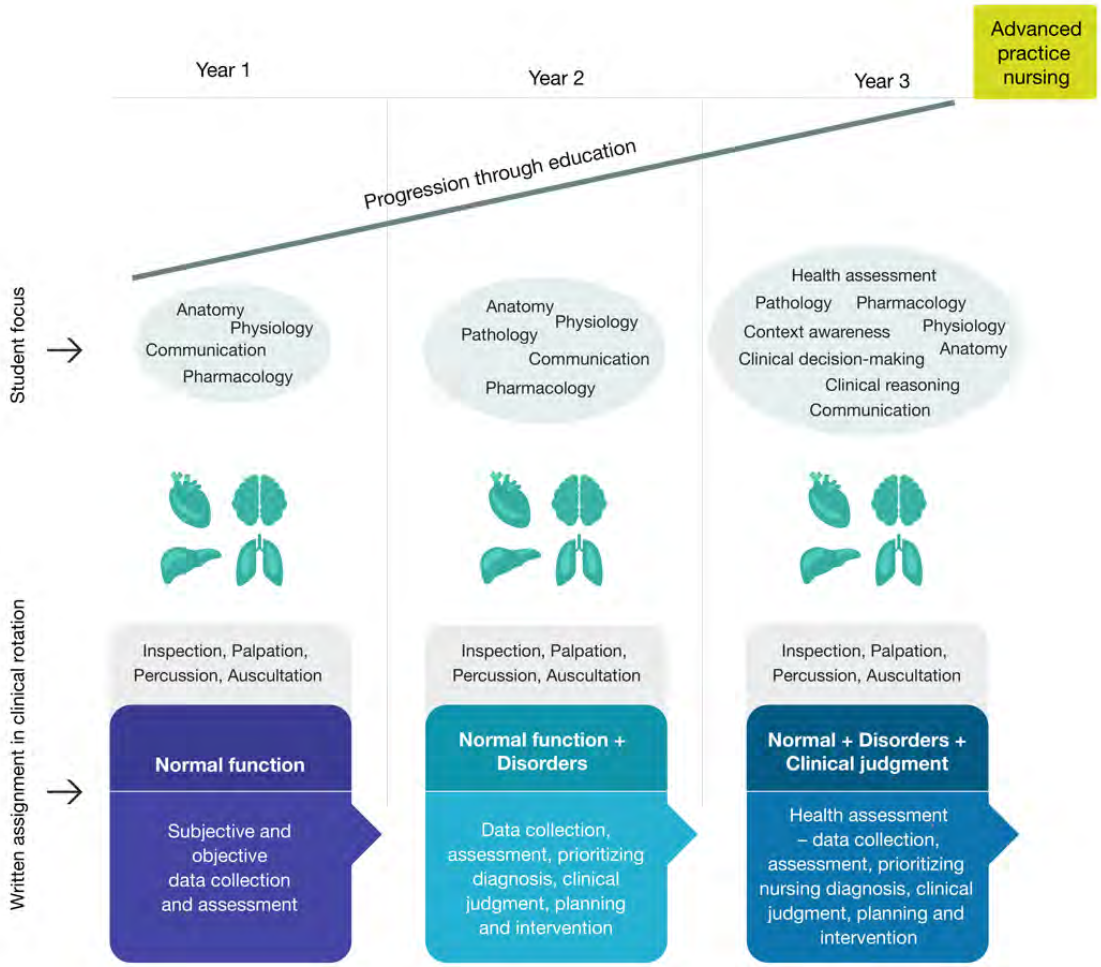
In nursing education, students navigate between multiple learning contexts during lectures and different clinical rotation periods. This requires students to handle and mitigate the differences between what is taught in universities and what they learn in the clinical rotation—this is commonly referred to as the theory-practice gap [9]. mLearning is shown to be a good strategy for reducing these challenges by supporting students in becoming less dependent on the learning context and increasingly self-directed in their own learning processes [10,11]. When considering the implementation of a suite of mLearning tools in nursing education, students should be core collaboration partners because of their role as end users [11,12]. Importantly, as nursing students are the ones who must navigate between multiple learning contexts, they should be the ones evaluating and testing mLearning and its possible content to determine what works for them and in what context [11]. As such, a participatory design involving co-design workshops (WSs) is a good method to highlight end user involvement and collaboration in the development and evaluation of the end product [12].

Rationale for Educational Focus in a Suite of mLearning Tools

Nurses base their clinical judgment on physical assessment and history taking to map their patients' health condition [13]. Physical assessment skills (PASs) are therefore one of the core competencies nurses must master [14]. Inadequate patient assessment might result in a failure to notice deteriorating patients and to initiate appropriate nursing interventions; this can threaten the safety of patients and result in adverse health outcomes [15,16]. However, performing adequate patient assessments can be challenging for novice nurses because of the complexity of health situations in the different patient groups that they encounter [16]. The nursing students learn PAS in preclinical courses at the university but apply these skills in clinical rotation. Therefore, learning and developing competence and confidence in performing PAS and the ability to articulate relevant knowledge are based on how these skills are taught on campus and on the supervision of preceptors during the clinical rotation [16,17].

Until recently, PASs were not a part of nursing education in Norway. To overcome the barriers identified in international studies [14], our university implemented selected PASs focusing on respiratory, peripheral circulation, abdominal, and neurological assessments in the curriculum in 2015. These PASs are considered to be the basic skills necessary for clinical competence for undergraduate nursing students and are, therefore, referred to as *Basic* PAS (B-PAS; Figure 1) [17].

Figure 1. Basic physical assessment skills progression model in Norwegian nursing education.



In a previous study, we identified that a lack of knowledge and practical use of B-PASs among the faculty and preceptors limited students in their learning of and performing these skills [17]. This points to a theory-practice gap with regard to developing these specific skills and underlying knowledge. This is concerning, as 50% of Norwegian nursing education takes place in clinical rotations in different contexts [18]. An additional result from this earlier study was that students identified mLearning as potentially enhancing their B-PAS learning processes. This finding is supported by other studies [19,20]. Research also highlights that mLearning can contribute to the articulation and integration of human bioscience knowledge (anatomy, physiology, pathophysiology, and pharmacology), which underpins knowledge-based basic physical assessment.

Thus, mLearning can support nursing students in learning and applying B-PASs in a clinical context without being solely dependent on guidance from their supervisors. mLearning may also contribute to better transfer of knowledge between multiple learning contexts, and it arguably works best in combination with other teaching methods and educational strategies [21-24].

There is a range of digital learning resources that are suitable for inclusion in a suite of mLearning tools highlighting B-PASs and relevant knowledge, for example, massive open online courses (MOOCs) [25], web-based apps, gaming [22], podcasts [26], multimedia presentations [27], and more comprehensive software involving immersive technology, such as digital simulation with virtual patients [28,29]. Digital simulation involves real people using digital and mobile technology to operate interactive virtual patient scenarios for educational purposes [30]. When reviewing the literature regarding factors facilitating or hindering the implementation of mLearning in medical and nursing education, Lall et al [31] not only identified high student satisfaction with mLearning but also revealed challenges related to the implementation process. These challenges existed both in universities and clinical settings and were related to faculty competence in using mobile technology, the acceptance of using mobile devices in different clinical settings, and students' access to the devices [31].

Therefore, the aim of this study is to co-design a suite of mLearning tools with nursing students to support their B-PAS learning and application. The specific objectives are to explore the following with students: (1) in what way does the selection of digital learning resources support B-PAS learning and application in clinical rotation; (2) which of the selected digital learning resources are beneficial when included in the suite of

mLearning tools; and (3) how the selected digital learning resources could support the transfer of knowledge from academic context to clinical settings.

Methods

Research Design

This qualitative longitudinal study was inspired by participatory design. Participatory design aims to involve end users in co-design and development processes with a specific purpose [12]. The co-design processes took place in several iterative WSs over a period of 3 months: 2 WSs with first-year students (n=6), 3 WSs with second-year students (n=6), and 3 WSs with third-year students (n=8). Through these WSs, the experiences and preferences of students were explored with the aim of informing the final selection of digital learning resources included in the suite of mLearning tools.

Recruitment and Sample

The nursing students were recruited from a bachelor's program in nursing at a large university in Norway. Information about the aim of this study and an invitation to participate were published on the learning management system (LMS) of the university, and a short presentation about this study was given orally on campus. Students signed up to participate by emailing the first author (ÖE) directly or via their course leader. The convenience sample consisted of 20 nursing students (14 women and 6 men) in the first, second, and third year of the program. The participants' ages varied from 20 to 50 years.

Procedure and Data Collection

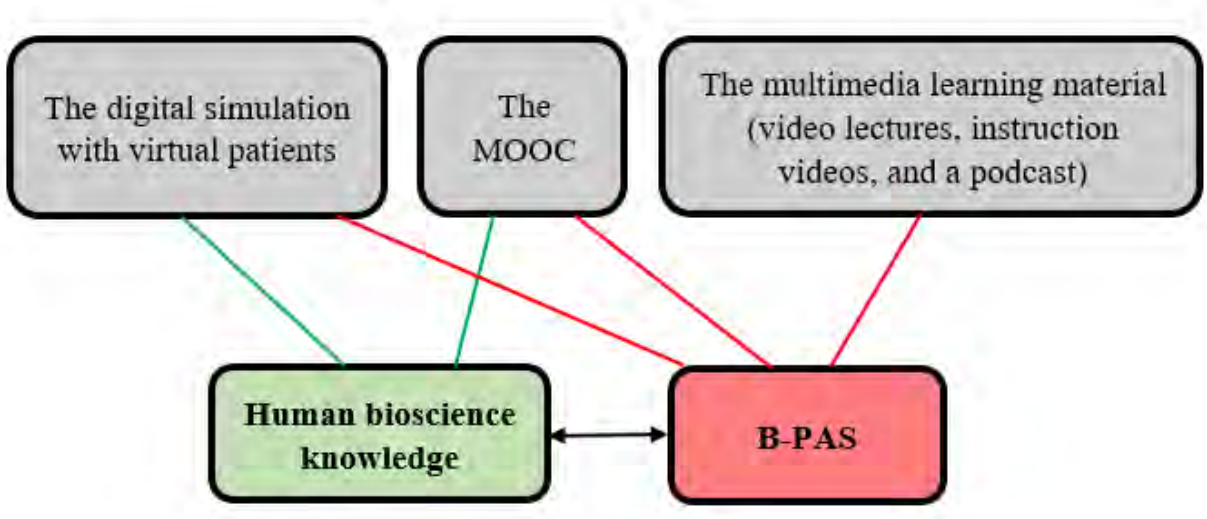
All the WSs were held in 2019 during the spring semester on the university campus. They were facilitated by the first author (ÖE), who was supported by one of the other researchers (EB, LH, or HE) during each WS. ÖE was also an active participant in the discussions. The main tasks for the facilitators were to involve all the students in the discussions, ensure that all planned topics were covered, and keep track of time and breaks. Each WS lasted a maximum of 2 hours, and the discussions were audio recorded. WSs 1 and 2 were transcribed verbatim, whereas WS 3 was worked with as audio files in which important statements were marked.

The Digital Learning Resources Suggested as Content in the Suite of mLearning Tools

A selection of digital learning resources highlighting B-PASs in different ways were introduced to and assessed by the participating nursing students. The digital learning resources included (1) a digital simulation program with virtual patients, (2) a MOOC, and (3) multimedia learning material (video lectures, instruction videos, and a podcast; Figure 2). These digital learning resources were new to most of the students.

The digital simulation program consists of several interactive virtual patient cases and can be used in groups or as an individual learning activity. One of the tasks in the digital simulation is to choose appropriate B-PASs and other interventions during assessment of virtual patients; the students also received feedback on their choice of assessments and the interventions performed in the program—fitting perfectly with the aim of the suite of mLearning tools. The MOOC is an individual e-learning course with 5 modules promoting students' assessment of vital signs and history-taking skills, notice of patient deterioration processes, and learning about more advanced skills (eg, auscultation of the lungs and heart). In addition, it was desirable to evaluate the selection of multimedia material, consisting of video lectures, instruction videos, and a podcast, all aiming to teach (verbally and visually) how to perform B-PASs on real patients. The podcast focused on giving the students perspectives on how to learn and focus on using these skills throughout their nursing education.

Figure 2. Learning focus for the different digital learning resources tested by the students. B-PAS: basic physical assessment skills; MOOC: massive open online course.



Content and Structure of Co-Design WSs

The researchers planned and framed the structure and content of the 3 WSs, which were generally based on the selected digital learning resources. Students engaged in the co-design processes by using and evaluating how the digital learning resources influenced their learning related to B-PASs and human bioscience knowledge during clinical rotation and in academic

courses. Figure 3 provides an overview of the processes in the co-design WSs.

The first WS included the introduction and discussion of 2 new learning resources: the digital simulation with virtual patients and the MOOC. We asked the students to evaluate and test these 2 digital learning resources individually before attending the second WS. In the second WS, we explored the experiences of students with using digital simulation and the MOOC. As B-PASs is built on knowledge of human biosciences, it was important to discuss with the students as to what type of learning material or assignments could facilitate coherence between theoretical knowledge of human biosciences and the application of these skills. The nursing students were asked to use and evaluate the multimedia learning materials (videos and podcast) before attending the next WS. In the third WS, we focused on discussing the students' feedback regarding the multimedia learning materials. Here, it was important to discuss the digital learning resources to be included and the ones to be excluded. In addition, we presented a pilot version of the suite of tools to give the students a visual example of how they might look in the LMS. This way, the students had the opportunity to give feedback and input regarding the first prototype. The participation of nursing students was relatively stable throughout the WSs; however, some students participated in only 1 WS (Table 1).

Figure 3. Co-design processes in the workshops. mLearning: mobile learning; MOOC: massive open online course.

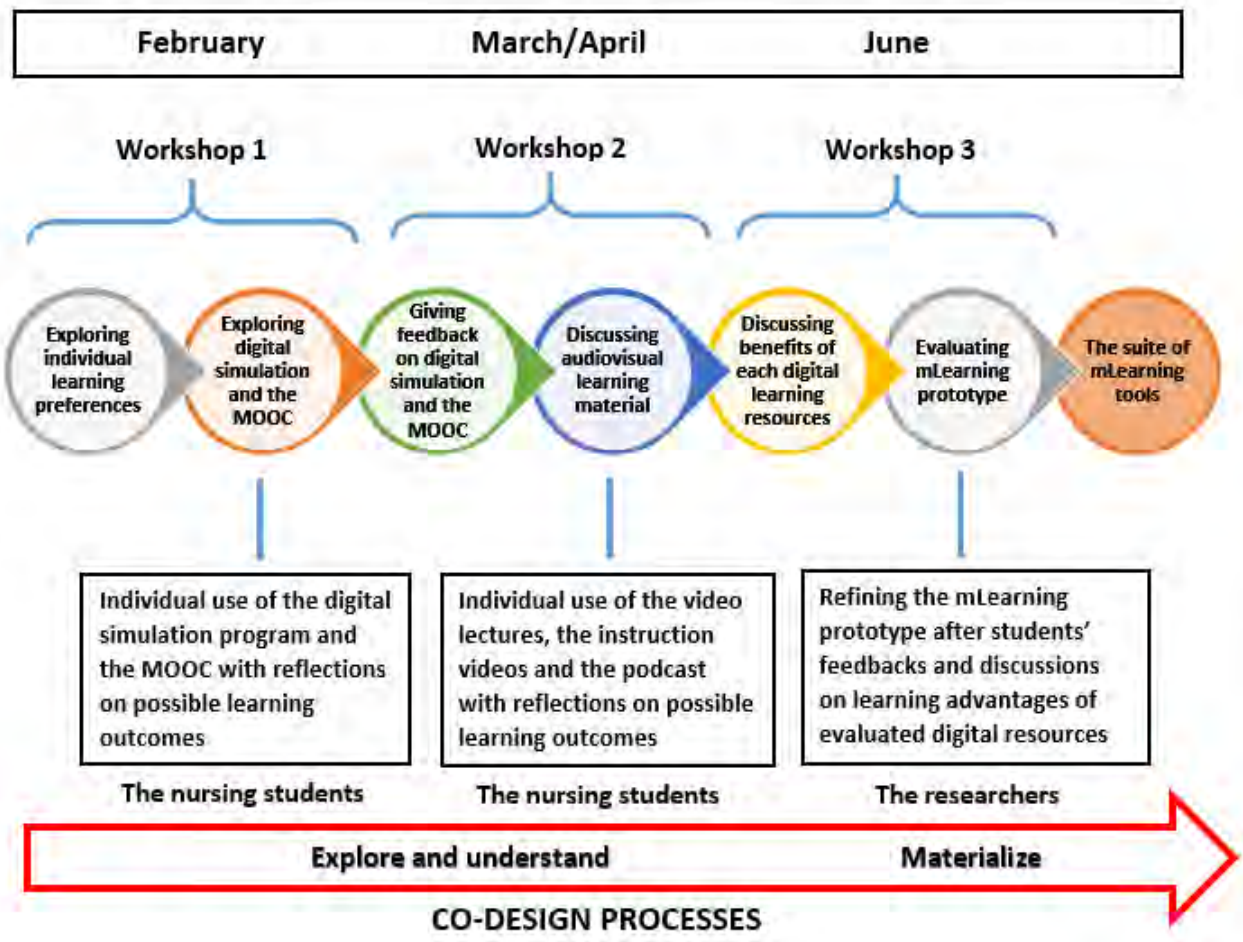


Table 1. Participation of nursing students in the workshops.

Student	WS[a] 1	WS 2	WS 3
First-year students			
Student 1	✓[b]	—[c]	—
Student 2	✓	—	—
Student 3	✓	✓	—
Student 4	✓	—	—
Student 5	✓	—	—
Student 6	—	✓	—
Second-year students			
Student 7	✓	✓	✓
Student 8	✓	✓	✓
Student 9	✓	✓	✓
Student 10	✓	—	—
Student 11	✓	✓	✓
Student 12	—	✓	✓
Third-year students			
Student 13	✓	✓	—
Student 14	✓	✓	✓
Student 15	✓	✓	✓
Student 16	✓	✓	✓
Student 17	✓	✓	✓
Student 18	✓	✓	—
Student 19	✓	✓	✓
Student 20	—	✓	—

[a]WS: workshop.

[b]Attending the workshop.

[c]Not attending the workshop.

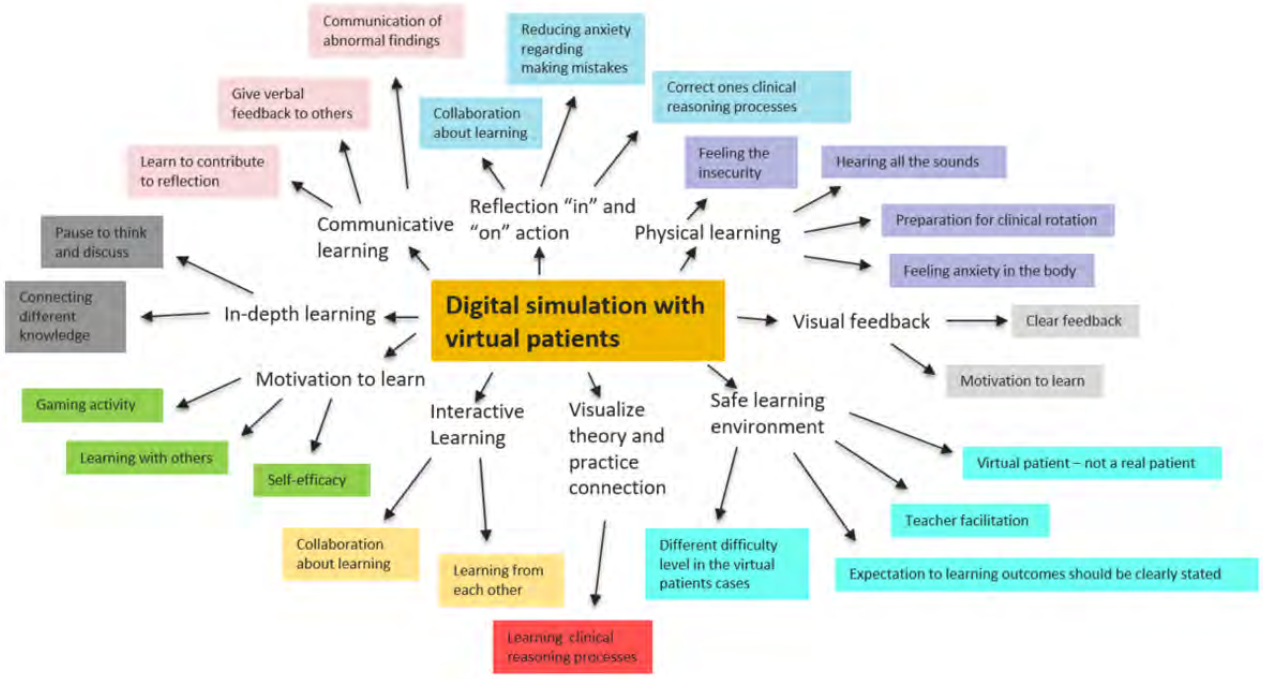
Research Ethics

The Norwegian Centre for Research Data approved the study (Reference number 462735). Written informed consent was obtained from all participants in accordance with the Declaration of Helsinki. Reviewing the learning resources was not a requirement to attend WSs 2 and 3. The researchers were not involved in evaluating the academic or clinical courses of the participants, and participation in this study had no impact on grading in any of the courses.

Data Analyses

Thematic content analysis was used to analyze data [32], which comprised text materials (WSs 1 and 2) and audio files (WS 3). The research questions guided this process. The text material from WSs 1 and 2 (all student cohorts) and the audio files from WS 3 (second- and third-year students) were read and listened to completely, respectively. Further analysis of the data included important concepts and statements involving the design of and suggested content in the suite of mLearning tools. Figure 4 shows an example of how the digital resources (in this case, the digital simulation with virtual patients) were creatively mapped to explore core concepts throughout the analyses of the data.

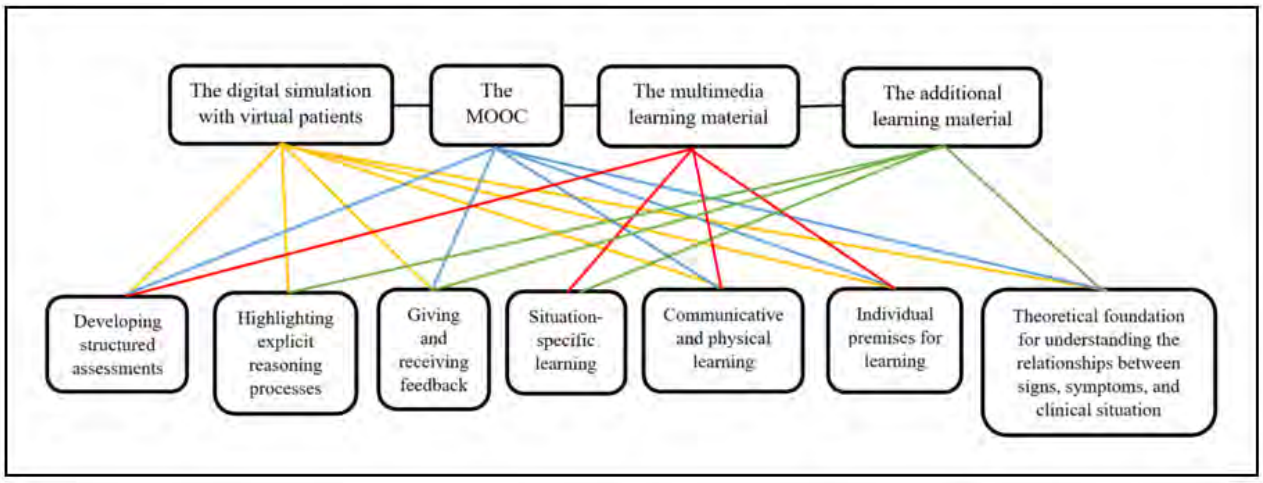
Figure 4. Example of a concept map in the analysis process.



Results

According to the students, the digital learning resources stimulated learning in 7 different ways: (1) developing structured assessment, (2) highlighting explicit reasoning processes, (3) giving and receiving feedback, (4) situation-specific learning, (5) communicative and physical learning, (6) individual premises for learning, and (7) the theoretical foundation for understanding the relationships between signs, symptoms, and clinical situation. Figure 5 shows how the digital learning resources contributed to student learning, both individually and collectively.

Figure 5. Contribution of digital learning resources to student learning. MOOC: massive open online course.



In the following sections, each digital learning resource and its influence on the learning process are presented. Students' own voices, in the form of quotations, are included in Textbox 1 to substantiate the data analyses. The content of the suite of mLearning tools is then presented.

Textbox 1. Students' quotations related to the evaluation and testing of digital learning resources; these quotes substantiate concept mapping and data analysis.

- The digital simulation with virtual patients:
  - Student 13 workshop (WS) 1: "I believe that this (digital simulation) will be very attractive for the students, it's a really cool way to learn and the students might be more motivated to learn anatomy and physiology, rather than sitting for six to seven hours listening to a lecture, which is really exhausting"
  - Student 17 WS 2: "There is always something that goes wrong. Then you have the opportunity to pause the simulation and review what you missed or what you did wrong. Luckily it is a fictive patient but you learn in what order you should do things"
  - Student 8 WS 1: "We get the opportunity to meet someone really ill in a totally safe environment"
- The Massive Open Online Course
  - Student 15 WS 3: "If the solution of the case is a stroke diagnosis and you didn't think of that, then there are obviously some really important cues that you missed"
- Multimedia learning materials
  - Student 14 WS 3: "It is really important to show the reasoning processes—it's not important what the conclusion is but just to show the reasoning processes"
  - Student 11 WS 2: "It would be perfect if lectures were available online. If you don't understand certain things and you are afraid to ask in the classroom, then you can just rewind and look at the material that is difficult to understand. You can also have the textbook beside you to try to figure it out"
  - Student 2 WS 2: "In order to recognize potential symptoms of a disease, you must know the normal body functions. Then you must know what to listen for—you cannot just listen to the lungs without knowing. It requires fundamental theoretical knowledge"
- Additional learning materials
  - Student 7 WS 3: "I would rather use my time and effort on something that gives me feedback on or an indication of my knowledge base, than on academic assignments in clinical rotation where I never get any feedback at all"
  - Student 15 WS 3: "There is something about being conscious regarding one's own feedback to other people. To be conscious about what word you use and how to give constructive feedback—and we will have to do that when we become supervisors for nursing students later"
- General design features for better end user experience
  - Student 11 WS 1: "A multimedia learning resource is an extremely effective learning tool within some courses—it is all about experimenting and finding out what works. But a well-designed digital learning resource can help to show how different knowledge is intertwined"

Digital Simulation With Virtual Patients

In general, all the students were excited about the digital simulation and the possibilities that this learning resource could offer for skills and knowledge development. The first-year students discussed how digital simulation could enhance their learning of human bioscience knowledge and the ability to connect it with other topics in nursing education. The second- and third-year students highlighted its usefulness related to the development of communication and clinical reasoning skills, as they learned to prioritize nursing interventions and focus on performing B-PASs. The nursing students also elaborated on their physical reactions in the situation. The sounds from the patient (eg, moaning in pain) and instruments (eg, changes in vital signs) made the students feel stressed, as they would have in a real patient situation. With this authenticity, the students felt that the digital simulation with virtual patients would contribute to physical and mentally preparedness for clinical rotation. The use of English in the digital simulation software created some challenges for most of the students; as such, they highlighted the value of working in their native language with regard to improving learning outcomes and the overall user experience.

After testing the digital simulation between WSs 1 and 2, the students emphasized the benefits of working together in a group rather than working with the virtual patient cases individually. The students also described how faculty was important when working in a group in the digital simulation sessions, with regard to promoting a safe learning environment, facilitating knowledge development, and collaborating within the group. The safe learning environment was viewed as a prerequisite for students' reflections *in* action and *on* action, influencing each other's learning processes by making it *safe* to actively participate in a discussion with one's peers.

Another important factor in the digital simulation was the opportunity to learn from making incorrect or suboptimal decisions without harming a real patient during the simulation. To enhance this learning outcome, the process of reflection during the simulation session and in the debriefing phase were crucial to understanding what went wrong. Through the digital simulation, the students also learned the importance of performing structured physical assessments; this included learning where to start gathering data for a thorough overview of the patient situation to initiate nursing interventions.

The nursing students also stressed that the digital simulation with virtual patients used in combination with theoretical classes and during clinical rotation periods might be a beneficial pedagogical strategy to enhance learning, especially in theoretical classes involving human bioscience knowledge. Some of the students in all 3 cohorts drew parallels to gaming experiences and discussed ways these may be helpful in the use of the digital simulation.

The MOOC

The structure of the 5 modules included in the MOOC appealed to the students. They found that elder care or community health care was the primary focus and suggested that the MOOC was best suited to the curriculum in the first and third years (in the Norwegian context). As some of the assignments were built on one specific clinical case, the students felt that a broader selection of cases would provide better knowledge development. The second- and third-year students especially liked how communication skills were emphasized in the MOOC. In their opinion, focusing on communication skills is as important as focusing on technical skills during clinical rotation. The nature of the assignments, such as listening to audio files, appealed to the second- and third-year students. Some of the assignments also required that they categorize patient data into objective or subjective data. In this manner, the MOOC supported students' learning regarding the value of working in a structured way when prioritizing data collection in clinical cases. Moreover, the clinical cases supported the cognitive processes involved in *catching the cues*, and for students, this was an important learning outcome of the MOOC.

Multimedia Learning Materials

The multimedia materials included video lectures, instruction videos, and a podcast. The students highlighted that the use of these learning materials supported different clinical situations, enabling them to selectively choose specific learning material before performing B-PASs with the patient. According to the students, this type of learning material can contribute to both knowledge development and self-efficacy. They found it helpful to have the learning outcomes clearly stated regarding the expected level of B-PAS performance. Students also valued the podcast format, which could be used to discuss clinical cases showing experienced nurses' clinical reasoning processes in action.

The students valued the functional possibilities offered by the multimedia materials, for example, they could pause the audio files to familiarize themselves with difficult concepts and then replay the audio files as often as necessary. Here, the auscultation skills were highlighted as especially challenging, particularly relating to the interpretation of lung and heart sounds. The students also suggested that the features in the multimedia materials could be simple animations, not necessarily actual patients, as the students have access to real patients during clinical rotation. Although they thought the use of animations instead of actual patients might contribute to a better understanding of the connection between human biosciences and the clinical situation, the students highlighted that the learning materials must be of high (sound and picture) quality.

Additional Learning Materials

The students found it helpful to include additional learning materials aimed at supporting knowledge transfer in and development of the suite of mLearning tools. This additional content consisted of tests with multiple-choice questions (MCQs), several clinical cases to choose among, and written assignments. The students also emphasized the inclusion of clearly stated learning outcomes related to this additional material, making it easier to understand the value of engaging with the learning material. They felt this could also contribute to knowledge development and self-efficacy. The students wanted access to the correct answers for the MCQ tests and the possible solutions for the clinical cases: they argued that this type of immediate feedback could help them understand their own level of performance and identify knowledge gaps. The students also suggested that it was important, for purposes of motivation and self-efficacy, to receive the results or feedback visually—perhaps with audio animation or a pop-up effect.

The students gave suggestions regarding how to structure this part of the suite of mLearning tools in a way that would trigger their curiosity and motivation to learn more. One suggestion was that correct answers in MCQ tests or clinical cases could *unlock* further advanced learning material. The students welcomed a written assignment targeting reflection on using the B-PAS during clinical rotation, preferably with a peer review; they felt that this would also provide them with experience in providing critical and constructive feedback. They did not want open peer review but preferred anonymity because of the different relationships between students and their own insecurities regarding giving peer feedback.

General Design Features for Better End User Experience

One important element of the co-design processes concerns the general design features that emerged from the WS discussions. The students emphasized that the suite of mLearning tools had to be easily accessible, have a logic structure, be compatible with smartphones, and be usable *on the go*. Students highlighted the importance and possibilities of linking the suite of mLearning tools to other relevant web-based resources. The second- and third-year students recommended limited access for first-year students to avoid overwhelming them with too much information. One solution that they suggested was to design a *lock* in the structure of the suite of mLearning tools that could be unlocked by the most motivated first-year students who are eager to learn more. It was also important for the students to have the possibility of being anonymous or to use avatars if the use of the tool was visible to other students.

The Suite of mLearning Tools Recommended From the Co-Design WSs

The co-design processes included all selected digital learning resources in the suite of mLearning tools aiming to support the B-PAS and knowledge development. The LMS of the university was used to structure the suite of mLearning tools, which enabled the students to access digital learning resources by using mobile devices. Table 2 provides an overview of the content available to the students and a short description of the different

digital resources. The content in the LMS had no fixed order, enabling students to access the content in which they were specifically interested. The co-design processes and the longitudinal research design allowed students to test and evaluate the selected digital resources when in different learning contexts, for example, in an academic context and in a clinical rotation context. In such cases, the student expressed that this suite of mLearning tools and the future use of mobile technology may have teaching and learning value in both theoretical and practical courses—a valuable educational component during challenging situations such as the current COVID-19 pandemic.

There was a small difference in what was planned for the first-year students to have access to. The written assignment was included for all years, but the element of peer review was excluded for the first-year students based on an assessment made by the older students and the research group. As none of the first-year students were able to attend the final WS, there was no opportunity to discuss with them the potential advantages or disadvantages of peer review. According to the second- and third-year students, the main strength of the suite of mLearning tools was that it offered different types of digital learning resources from which to choose. Thus, these students found it useful to include all of the selected and evaluated digital learning resources in the suite of mLearning tools.

Table 2. Overview of the structure and content of the suite of mobile learning tools in the learning management system.

Different digital learning resources	Elaboration of the content
	A short description of the digital simulation program, information about the sessions, and the virtual patient cases on which students can work. Also included are log-in details and information about whom to contact if there are problems with the log-in
	A brief description of the MOOC[a] and recommendation for which modules students should focus on, depending on which educational year they belong to. The students also find details here regarding the log-in process
	Detailed information about auscultation skills, divided into 2 sections: (1) lung sounds and (2) heart sounds. Each section contains links to YouTube videos and audio files with different sounds to which students may listen
	A total of 5 instruction videos with a nurse performing B-PASs[b] on a patient. Each video has a specific focus: the heart and peripheral circulation, the respiratory system, the abdomen, the neurological assessment, and recording vital signs. The duration of the videos is from 7:37 to 15:51 min
	A total of 4 video lectures in which each video has a specific focus: the heart and peripheral circulation, the respiratory system, the abdomen, and the neurological assessment. The duration of the videos is from 13:13 to 32:55 min
	• Two nurses (faculty members) talk about the origin of the physical assessment in nursing education and the differences between performing B-PASs as a RN[c] or as a nurse practitioner • A conversation between the faculty members and 2 newly graduated RNs, focused on working with B-PASs throughout the 3-year nursing program, and how they work with B-PASs as new RNs

Different digital learning resources	Elaboration of the content
	Brief information about how to structure professional communication about data gathered by mapping the patient health condition through the use of different communication tools and how to use these tools during clinical rotation
	Information about how to structure the professional documentation of the information gathered through mapping the patient health condition by using B-PASs in the different documentation systems used in clinical practice
	MCQ[d] aiming to support students' knowledge, to repeat and refresh bioscience knowledge, and to identify knowledge gaps
	Description of a written assignment targeting reflection on the use of B-PASs. Feedback is given by fellow students (a peer review for the second- and third-year students) in which all parties are anonymous
	Checklists summarizing the elements of every focus in B-PASs (eg, respiratory system and neurological assessment). Can also be used when students use B-PASs in clinical rotation

[a]MOOC: massive open online course.

[b]B-PAS: basic physical assessment skill.

[c]RN: registered nurse.

[d]MCQ: multiple-choice question.

Discussion

Principal Findings

This study explored the use of the participatory design method to co-design a suite of mLearning tools specifically aimed at supporting the learning and performance of B-PASs and integration of human bioscience knowledge. As such, this study expands the use of mLearning with its explicit focus on the learning and application of practical skills, thus contributing to a better understanding of how different digital learning resources, individually and collectively, influence students' learning and application of skills in nursing education.

The Contribution of Digital Learning Resources to Enhance Learning of Skills and Knowledge

The most important findings of this study are regarding how the digital learning resources in the suite of mLearning tools enhanced learning processes related to specific categories of skills and knowledge. The digital learning resources stimulated the learning and application of B-PASs from a multidimensional perspective: from physical (motor) learning to the articulation of integrated theoretical knowledge and the enhancement of context-specific learning processes (Figure 5). Access to the suite of mLearning tools appears to have impacted the development of self-efficacy related to B-PASs in nursing students. As such, the students might perform B-PASs more frequently, and perhaps better, while also applying human bioscience knowledge in clinical reasoning processes. This is in line with other studies showing that students value access to different kinds of mobile resources to support and enhance learning [6,8,30,33-35]. The results of this study are also interesting, as although nursing students already use a variety of mobile apps—for example, drug calculators, medical dictionaries, handbooks, and clinical skills guides [6,8,33]—our suite of mLearning tools still seems to have added value. Nevertheless, there is a need for further exploration of how mLearning should be implemented across the nursing curriculum; this could be done by critically exploring which learning processes mLearning aims to support. Although mLearning alone might not be the best educational strategy in nursing education, in combination with other activities, it might represent a good educational approach [17,23].

Digital simulation with virtual patients was the preferred learning resource by students. The students not only valued the possibility of a new and innovative learning activity that the digital simulation offered but also highlighted that the involvement of faculty was crucial to facilitate good learning processes in this context. This facilitation role also involved creating a safe environment that allowed reflection *in* and *on* actions during the simulation session. The role of facilitation in digital simulation with a focus on B-PASs, both for the teacher and the preceptor, needs to be further developed. Although digital simulation as a part of the suite of mLearning tools is an individual learning activity, it also seems to be important to plan the digital simulation as a group activity to increase the learning outcome. As we have shown earlier and, in this study, because of a lack of adequate supervision with regard to B-PASs [17], the suite of mLearning tools plays an important role in supporting the learning and development of these skills and knowledge. Research shows that digital simulation alone can strengthen self-efficacy, performance of clinical skills, decision making [28], clinical reasoning processes [35,36], and nontechnical skills [37] of students. This indicates that including digital simulation with virtual patients contributes to better learning of skills, and that reflection contributes to the articulation of human bioscience knowledge, promoting clinical reasoning skills.

Supporting Knowledge Transfer Between Different Learning Contexts for Skills Training

Another interesting finding of this study is how the co-design processes and the WS discussions revealed in what way digital learning resources can support knowledge transfer between different learning contexts. The suite of mLearning tools seemed to contribute to more seamless learning processes and thereby contributed to bridging the theory-practice gap in nursing, creating a more self-directed learning space for nursing students.

Lewin et al [37] argue that technology changes the boundaries of different types of learning (formal and informal) and learning spaces. This opens new ways to connect and combine different learning sites in higher education. As such, collaboration between universities and clinical settings may promote the creation of new knowledge and learning spaces, in which these institutions are equal partners in influencing learning and competence development in students. Chan et al [38] have termed this *seamless* learning: seamless learning processes enable students to navigate between different spaces and different roles, and to interact with different educational practices—for example, the university, the clinical setting, and the suite of mLearning tools [38]. As such, the suite of mLearning tools can promote transferability between learning contexts in nursing education. Therefore, further development and implementation should occur in close collaboration with students, the university, and the clinical setting.

However, the implementation of new and innovative teaching and learning strategies, such as the suite of mLearning tools, can face obstacles in both university and clinical settings. It is important for these obstacles to be identified and addressed to best support student learning. Attitudes of nursing staff, patients, and patients' families toward the use of mobile devices may hinder their use of these devices [8,30,33,39]. The nursing students in our study reported similar experiences. It was also important for the students to be able to access the learning materials anywhere, at any time. Hsu and Hsiang [6] recommend that mLearning should support offline activity to secure a better end user experience. Taking this into consideration when designing and using a suite of mLearning tools in nursing education might enhance students' experience of mobile technology as a pedagogical approach. This also highlights the importance of continuing to explore how mobile technology can be successfully implemented and support the teaching role of the faculty and the preceptors.

Limitations

This study has several limitations that must be noted. The first-year students were absent in WS 3, which limited the opportunity to discuss with them the structure and the final content of the suite of mLearning tools. This needs to be explored in future studies. In addition, the students participating in this study might not necessarily represent the diversity of the university's student population but rather those motivated students with the ability to participate in extracurricular activities. The use of the suite of mLearning tools should be tested by the entire student population to explore this further. Finally, the focus of the study was on the experience of the students with mLearning, not the perspectives of the faculty or

preceptors, representing another limitation that should be addressed through future research.

Comparison With Previous Work

The longitudinal design in this study offered opportunities to assess the different digital learning resources in 2 contexts: the university and clinical rotation. This process also strengthened the authenticity and the *here and now* experiences in the processes of assessing the feasibility and benefits of learning resources. O'Connor and Andrews [11] have shown the benefits of using a co-design approach with nursing students when designing an educational app supporting clinical skills in general and not specifically for B-PASs. Previous research in the field of mLearning related to PAS has only tested 1 app without involving students in the development process [6], whereas other studies have only focused on a single digital learning resource [24,26,28]. In contrast, this study explores multiple digital learning resources with high student involvement and identified the different impacts on students' learning. The literature also highlights the need to reassess the educational strategies used to teach PASs to ensure that these skills are applied in a clinical setting [17,40,41].

Conclusions

Students valued the invitation and opportunity to collaborate in co-design processes, thereby influencing the nursing education content. The longitudinal research design structuring the collaboration with students was essential to understanding what works and in which context. The nursing students viewed the suite of mLearning tools as beneficial for supporting B-PAS learning and their application during clinical rotation. Our findings indicate that one of the strengths of the suite of mLearning tools was its inclusion of all the different digital resources tested by the students; this variety in content met the different learning preferences and needs, enhancing B-PAS learning and human bioscience knowledge of the students. Therefore, the suite of mLearning tools may be a beneficial additional pedagogical strategy that supports knowledge and skills transfer between academic and clinical settings. Further studies are needed to explore different perspectives related to the use of mobile technology and mLearning (ie, faculty and preceptors), pedagogical strategies, and scaffolding learning material to better understand how mLearning can be used in nursing education.

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Authors' Contributions

All authors contributed to the different phases of the research process. ÖE drafted the manuscript, and all coauthors contributed to data analyses and further writing of this manuscript, the final draft of which was read and approved by all authors.

Conflicts of Interest

None declared.

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Abbreviations

B-PAS: basic physical assessment skill
LMS: learning management system
MCQ: multiple-choice question
mLearning: mobile learning
MOOC: massive open online course
PAS: physical assessment skill
WS: workshop

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Factors associated with changes in students' self-reported nursing competence after clinical rotations: a quantitative cohort study

H. Ösp Egilsdottir[1*], Lena Günterberg Heyn[1], Ragnhild Sørum Falk[2,3], Espen Andreas Brembo[1], Kirsten Røland Byermoen[1], Anne Moen[4] and Hilde Eide[1]

Abstract

Background The quality of nursing care in different healthcare contexts can be associated with the level of available nursing competence. Physical assessment skills are vital in nurses' assessment of patient care needs. However, in nursing education, using physical assessment skills is challenging for nursing students who struggle to apply these skills comprehensively in a clinical rotation. Therefore, this study explores changes in nursing competence, factors associated with changes after clinical rotations, and whether a Suite of Mobile Learning Tools supports changes in confident use of basic physical assessment skills.

Methods A quantitative cohort study with an explorative pre-and post-test design. During autumn 2019 and spring 2020, 72 s-year nursing students and 99 third-year students participated in the study. The Nurse Professional Competence scale short form was used to investigate students' self-reported changes in nursing competence, and a study-specific questionnaire was used to investigate students' confidence concerning performing physical assessments. The students voluntarily used the Suite of Mobile Learning Tools for the learning of physical assessment. Linear regression analysis was used to identify factors associated with changes in nursing competence after clinical rotation. The STROBE guidelines for cohort studies were followed for study reporting.

Results After the clinical rotation, both student groups reported changes in nursing competence and confidence in performing physical assessment skills, with statistically significant moderate or large changes in all areas. The Suite of Mobile Learning Tools was evaluated as being useful for learning physical assessment. The regression analysis showed that confidence in performing physical assessment skills, the usefulness of the Suite of Mobile Learning Tools, and a higher nursing competence at the start of clinical rotation were positively associated with overall nursing competence.

Conclusion Basic physical assessment skills are an important component of nursing competence and can be considered one of the pillars of person-centered care, as proposed by the Fundamentals of Care framework. Spaced repetition and access to digital resources are suggested pedagogical approaches to enhance student confidence in the use of assessment skills within academic and clinical contexts.

Keywords Nursing students, Clinical placements, Confidence, Nursing care, Physical assessment skills, Clinical skills, Nursing competence, Mobile learning

*Correspondence:
H. Ösp Egilsdottir
osp.egilsdottir@usn.no
Full list of author information is available at the end of the article

Background

Highly skilled and competent nurses are increasingly needed in all clinical healthcare contexts due to demographic population projections, emerging new treatment modalities and technologies, task shiftings and new professional responsibilities, and global health challenges [1]. The overall quality of patient care provided can depend on the availability of competent nurses [2, 3]. Undergraduate nursing education, with its combination of theoretical and practical learning objectives and outcomes, intends to provide graduated nurses with the necessary nursing competence to provide safe and high-quality patient care. Nursing competence is a multidimensional and dynamic concept encompassing nurse's knowledge, understanding, judgment, and cognitive, technical, psychomotor, and interpersonal skills [4, 5]. Systematic and structured health assessment is a core element of nursing competence, crucial for the nurse's clinical reasoning capacity and ability to provide person-centred holistic care [4, 6].

Performing health assessments includes a collaboration between the nurse and the patient, where the focus is on assessing the health situation and collecting objective information about the patient and subjective information from the patient [6]. Through a systematic and structured approach, a full and comprehensive health assessment entails a) physical assessment, where the nurse uses a range of assessment skills to collect the needed objective information, and b) history taking, where the nurse uses communication skills to inquire subjective information [6]. Subsequently, the nurse collaborates with the patient to identify current care needs, followed by clinical decision-making to determine appropriate nursing interventions. As such, health assessments are vital for the nurse's scope of practice [7].

Despite the importance of mastering physical assessment skills within health assessment processes, research shows that nurses only use a limited range of their learned physical assessment skills in clinical practice [8, 9]. Moreover, the question of whether too many physical assessment skills are being taught in undergraduate nursing education has been raised [7–9]. Different studies have identified which skills are most frequently used by nurses in clinical practice [9, 10]. Therefore, to ensure "depth" instead of "breadth" of skills, careful consideration was done related to which physical assessment skills to prioritize in the undergraduate nursing education program at our university, termed Basic Physical Assessment Skills (B-PAS) [11]. The examination techniques in B-PAS consist of inspection, palpation, percussion, and auscultation, which are used to systematically collect relevant information. B-PAS is structured after four body systems a) respiratory assessment, b) peripheral circulation and heart assessment, c) abdominal assessment, and d) neurological assessment. These assessments comprise nurses' most frequently used skills [7–10].

To scaffold the nursing students' (hereafter "students") learning and training of B-PAS throughout the three-year bachelor's nursing education, a Progression Model was developed (Supplementary File 1, [11]). The pedagogical assumption "spaced repetition" underpinning the model assumes that applying, training, and repeating the same skills through all three years will enhance students' confidence in using B-PAS., The effect of practicing the same elements in different contexts leads to increased learning [12]. Perceived confidence, also known as self-efficacy is a person's belief in their ability to successfully perform a certain task [13] in this case, B-PAS. Self-efficacy can strongly impact learning outcomes when developing more confidence through repeated success when performing certain tasks [13]. This is facilitated through repetitive training in using and performing B-PAS with peers and faculty in the university's skill lab and clinical rotation. The increasing complexity of the health assessment and use of B-PAS in different contexts throughout the three-year education program is emphasized in the Progression Model by including and highlighting cognitive, clinical, and relational skills [11]. Furthermore, learning, the transfer of knowledge, and students' successful utilization of specific skills across different contexts is a complex process where contextual factors play a key role [14]. To better support the learning of B-PAS in different contexts, a Suite of Mobile Learning (mLearning) Tools was co-designed with students, enabling training that supports skills acquisition and knowledge transfer processes between educational and clinical contexts [15]. Specific questionnaire items were developed for the current study to map students' perceived confidence in using B-PAS in clinical rotation and the usefulness of the Suite of mLearning Tools.

Basic physical assessment skills, Fundamentals of Care, and nursing competence

The Fundamentals of care (FoC) Framework provided a lens for interpretation of students' self-reported data in the study. The framework highlights the core dimensions of nursing [16] and has also been described by Kitson [17] as a point-of-care nursing theory. The FoC Framework emphasizes factors influencing the delivery of person-centered care in a three-layer model. A prerequisite for person-centered care is establishing a therapeutic relationship between the nurse and the patient (and their family) [16]. The FoC Framework is divided into three main areas: a) the nurse–patient relationship (which within the context of this study represents the student–patient relationship), b) integration of care, and

c) contextual factors. The nurse–patient relationship is further underpinned by dynamic processes based on the following five elements: i) establishing trust, ii) being focused on the patient, iii) anticipating the patient's spoken and unspoken care needs, iv) engaging in knowing the patient through communication, and v) evaluating the provided care with the patient and/or their family [16]. The second area, integration of care, addresses the holistic approach to physical and psychosocial care needs that depend on the relational caregiver's (i.e., nurse/student) actions. This dimension of the model draws attention to the patient's fundamental care needs, for example, emotional wellbeing, mobility, and feeling safe. The third area, contextual factors, are factors at a system and policy level that influence the integration of care and the relationship between the student (nurse) and the patient. These factors can include employee resources, the organization of care, the ward culture, and regulations in the healthcare sector [16]. The patient's essential needs—which the nurse's assessment should capture—thus depend on the current health situation and in which context the care is or should be provided.

It has been argued that biomedical perspectives have dominated contemporary nursing practice with an increased focus on specific tasks, checklists, and cost-effective organization of care. This can lead to an overly instrumental and technical understanding of nursing care and a devaluation of other key aspects conceptualized as fundamentals of care— with a corresponding risk of losing sight of other core elements of nursing care [16]. For example, the value of the nurse–patient relationship underpinned by person-centered beliefs and values [16]. Our perspective, in conducting the current research is that integrating those perspectives does not exclude one or the other perspectives: both knowledge traditions are essential for nurses to deliver high-quality care and enhance patient safety.

Despite being underpinned by biomedical knowledge (for example, pathophysiology and anatomy), performing health assessments including B-PAS is an important part of the student (nurse)–patient relationship in the FoC Framework. Thus, gathered subjective and objective (through using basic physical assessment skills) information and students' knowledge about the patient greatly influences their assessment and selection of interventions toward the processes of integrating care and preventing the likelihood of missed care needs. However, the outcomes of health and physical assessments rely heavily on how the relationship and collaboration are between the student and the patient. The level of competence (for example, regarding communication, relational, and clinical skills) that the student brings into the student–patient relationship influences the integration of care [16, 18]. Acquiring skills to communicate, collaborate, and confidently perform B-PAS in a person-centered way can enhance the patient's feelings of trust, being cared for, and being informed about their health condition. On the other hand, if a student lacks communication skills and confidence in performing B-PAS, this increases the risk of missed care needs and hinders successful integration of care.

Students' abilities in providing person-centered care have been associated with their level of nursing competence [19]. No survey has been developed to measure or explore the integration of care in the FoC Framework. However, several instruments have been used to assess students' level of competence: for example, the Nurse Professional Competence scale short form (NPC-SF; 20). The NPC-SF measures self-reported nursing competence related to six competence areas: a) Nursing Care, b) Value-Based Nursing Care, c) Medical and Technical Care, d) Care Pedagogics, e) Documentation and Administration of Nursing Care, and f) Development, Leadership, and Organization of Nursing Care (Supplementary File 2; [20]).

The NPC-SF has been used to measure students' competence at the point of graduation and nurses' self-reported competencies shortly after graduation [20, 21]. Research shows that students typically achieve higher scores related to areas of Nursing Care, Value-Based Nursing Care, Medical and Technical care, and Documentation and Administration of Care. The competence areas related to Development, Leadership, and Organization of Nursing care, and Care Pedagogics seem to represent areas where students report lower competence scores [21–23]. However, the role of B-PAS in relation to these six competence areas has not been explored. From an educational perspective, it is essential to continuously identify changes in nursing competence in undergraduate nursing programs [3]. This is regarded as a key strategy that can provide clear recommendations about needed improvements in the curriculum, which can help secure the relevance and quality of the overall competence students achieve by the end of nursing education [3, 20]. To our knowledge, no study has systematically explored the changes in students' competence after clinical rotations in the different educational years, their perceived confidence in performing B-PAS (the examination techniques), and the usefulness of having access to a Suite of mLearning Tools—or the associations between components.

The study

Aims

This study aimed to explore changes in nursing competence, factors associated with changes after clinical

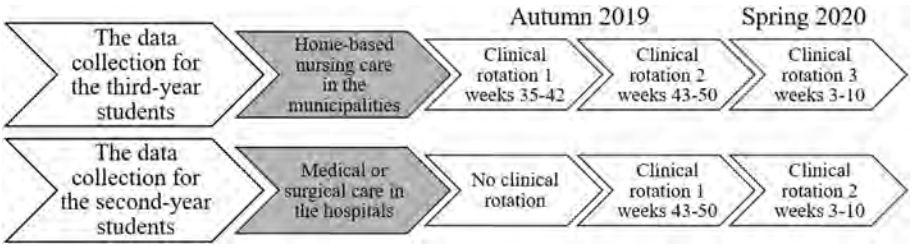

Fig. 1 Overview of the clinical rotation periods where the data was collected before and after these clinical rotation

rotation, and whether a Suite of mLearning Tools supports changes in confident use of B-PAS. The specific research questions were:

1. How do the students evaluate the Suite of mLearning Tools supporting the use of B-PAS in clinical rotation?
2. Do the students report changes in confidence in performing B-PAS after one clinical rotation in the second and third educational years?
3. Do the students report changes in competence after one clinical rotation in the second and third educational years?
4. Which factors are associated with the changes in overall nursing competence?

Design

This is a quantitative cohort study with an explorative pre-and post-test design. The cohort study design is particularly useful due to exploring the differences between the second- and third-year students [24]. The STROBE guidelines for cohort studies were followed for study reporting (Supplementary File 3).

Participants

All second-and third-year students at one university campus were invited to participate in the study. The students received oral and written information about the study (regarding the aim, voluntary participation, the content of the Suite of mLearning Tools, and how to withdraw from the study). The oral information was provided in classes before the planned clinical rotation and the written information was posted on the university's learning management system, Canvas. The same information was also presented at the simulation center when the students participated in the preparation classes before the clinical rotation, together with a presentation of the Suite of mLearning Tools.

The Suite of mLearning Tools

The Suite of mLearning Tools that was, as reported earlier, co-designed with students in 2019, from all three years in the nursing education program [15], accessible on Canvas by personal computer, tablet, or smartphone and was available only for the students participating in the study. The Suite of mLearning Tools contains a careful selection of tailored digital learning resources aimed to support the learning and application of B-PAS [15]. The participating students could access the Suite of mLearning Tools as much or as little as they preferred during the eight weeks of clinical rotation. Hence, the extent of students' use of the Suite of mLearning Tools was voluntary. Non-participating students received the ordinary clinical rotation, as described in the Progression model [11], but did not have access to the Suite of mLearning Tools. An overview of the content of the Suite of mLearning Tools can be found in Supplementary File 4 [15].

Data collection

Data collection was carried out in the autumn of 2019 and the spring of 2020 when the second-year students had entered their medical or surgical clinical rotation period in hospitals, and when the third-year students had started their home-based nursing care clinical rotation period in the community healthcare services (Fig. 1). The clinical rotation periods were organized in both the autumn and spring semester and the data were collected before and after one of the clinical rotation periods. The supervision model was the same for all the clinical rotations entailing that the preceptor supervised only one nursing student during the eight weeks of clinical rotation.

The data collection procedure was identical in all the clinical rotation periods. The before-clinical-rotation (pre-test) questionnaire was administered to both student groups at the university campus before the students started their respective clinical rotations. The first author was available for potential questions regarding the questionnaire. The faculty members supervising the students in the clinical rotation collected the after-clinical-rotation (post-test) questionnaire in situ. Both

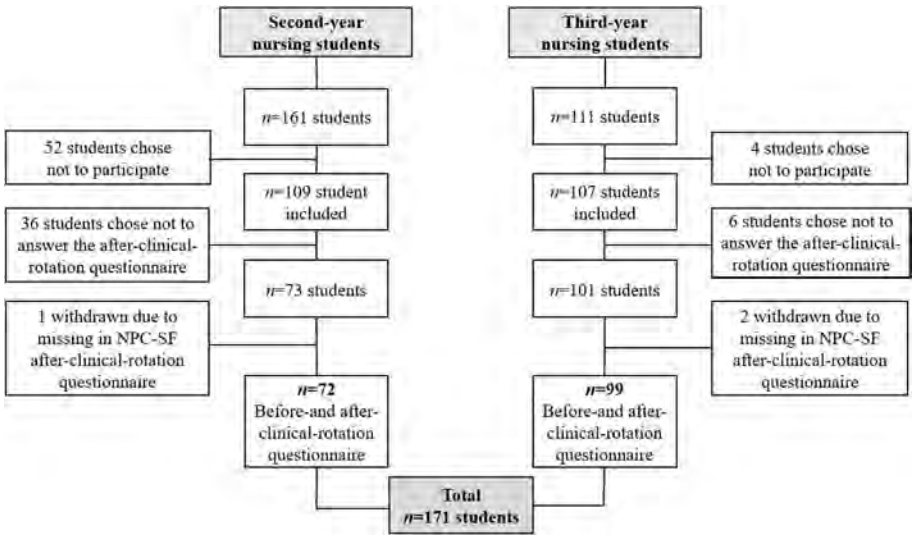

Fig. 2 Total number of participating students in the study

questionnaires were administered via paper and pencil. A total of 109 (of 161, or 68%) second-year students and 107 (of 111, or 96%) third-year students answered the before-clinical-rotation questionnaire (Fig. 2). Among the participating students, 73 (45%) of the second-year students, and 101 (90%) of the third-year students returned the after-clinical-rotation questionnaire.

The questionnaires

The questionnaire consisted of four sections: a) the Nurse Professional Competence scale short form (NPC-SF), b) items measuring students' perceived confidence related to performingB-PAS, c) items related to students' evaluation of the Suite of mLearning Tools, and d) the sample characteristics.

The nurse professional competence scale short form (NPC-SF)

The NPC-SF measures self-reported nursing competence through 35 items distributed across 6 competence areas (Supplementary File 3). The 35 items are presented as a question starting with "Do you think you have the ability to…" followed by an example of a competence statement relevant to nursing. One example is "Do you think you have the ability to respectfully communicate with patients, relatives, and staff?" Another example is "Do you think you have the ability to independently perform or participate in examinations and treatments?" The participants were asked to express how much they agreed with each item by using a 7-point Likert scale, where 1 = to a very low degree, 2 = to a relatively low degree, 3 = to some degree, 4 = to neither low nor high degree, 5 = to some degree, 6 = to a relatively high degree, and 7 = to a very high degree. The subscales for the six competence areas were converted into scores between 1 and 100, where 100 indicates the highest possible self-reported competence score [20].

Confidence in performing B-PAS

A questionnaire with 13 items was created for this study to map the student's perceived confidence related to the examination techniques in B-PAS: inspection, palpation, percussion, and auscultation. In the respiratory and abdominal assessments, all four techniques are relevant for use. In the peripheral circulation and the heart assessment, three techniques are used (inspection, palpation, and auscultation), whereas in neurological assessment, only two techniques are relevant (inspection and palpation). The questionnaire items were formulated for the examination techniques within each B-PAS area and in line with Bandura's [13] description of self-efficacy. A 7-point Likert scale ranging from 1 (to a very low degree) to 7 (to a very high degree) was used for all responses. An overall confidence B-PAS score was created as a sum of the 13 items converted into a 1 to 100 score, where 100 indicates the highest possible perceived confidence score.

Evaluation of the Suite of mlearning Tools

Eleven items were created to assess the extent to which each of the components of the Suite of mLearning Tools had contributed to the students' use of the B-PAS. In addition, one item was created to ask the students to evaluate the overall influence of the Suite of mLearning Tools on the use of B-PAS in clinical rotations. The same 7-point Likert scale as for the NPC-SF and confidence was used for the responses.

Table 1 Correlation table for the construction of the overall NPC-SF score

After clinical rotation			CA 1	CA 2	CA 3	CA 4	CA 5	CA 6	Overall NPC-SF score
	Mean[h]	*SD*	*r*	*r*	*r*	*r*	*r*	*r*	*r*
CA 1[a]	81.8	10.1							
CA 2[b]	88.3	8.5	.580						
CA 3[c]	82.2	9.5	.717	.627					
CA 4[d]	78.4	10.6	.565	.576	.625				
CA 5[e]	83.7	9.0	.687	.629	.786	.581			
CA 6[f]	71.0	12.4	.575	.490	.692	.660	.682		
Overall NPC-SF score	80.9	8.4	.813	.751	.892	.794	.887	.846	
Overall B-PAS[g] confidence score	75.6	12.2	.463	.372	.537	.350	.519	.412	.534

[a] Nursing Care

[b] Value-Based Nursing Care

[c] Medical and Technical Care

[d] Care Pedagogics

[e] Documentation and Administration of Nursing Care

[f] Development, Leadership, and Organization of Nursing Care

[g] Basic Physical Assessment Skills

[h] Scores ranged from 1 to 100, where 100 indicates the highest possible self-reported competence/confidence score

Sample characteristics

The nursing students provided background information such as age, gender, educational course, and work experience before enrolling in nursing education and on whether they had work experience in the healthcare sector.

Ethical considerations

The Norwegian centre for research data (NSD) approved the study (Project No. 674624). According to the national regulations, further approval from a medical ethical committee was unnecessary since the purpose of the study was not to generate new knowledge about health and illness. The institutional research board at the university approved the study. All participants were informed about confidentiality, voluntary participation, the use of the Suite of mLearning Tools, how to withdraw from the study, and how the researchers would store and manage the collected data. After signing the informed consent form, the students were given access to the Suite of mLearning Tools in Canvas. The students were also informed that participation in the study would not influence the formal evaluations they received in the clinical rotation period.

Data analysis

The statistical package IBM SPSS version 28 was used for data analysis [25]. Descriptive statistics were presented as frequencies with proportions for categorical data and as mean with standard deviation, median, and range for continuous data. The missing data in the NPC-SF were replaced with a group mean within each item, as described in Gardulf et al. [3]. Questionnaires with more than 60% missing data were excluded ($n=3$). The same procedure was performed with missing items related to mapping students' confidence. The difference between before and after clinical rotation measurements in the NPC-SF's six competence areas and the student's confidence was compared by paired sample *t*-test. If $p=<0.001$, Cohen's d was calculated and interpreted as a small (>0.2), moderate (>0.5), or large (>0.8) effect size [26].

Construction of the overall NPC-SF score

To further explore changes in students' competence, a decision was made to construct an overall NPC-SF score, comprising the sum of the 35 items converted into a 1 to 100 score, where 100 indicates the highest possible self-reported competence score. It was conditional that the overall score had a positive relationship with all six competence areas within the NPC-SF instrument. The correlation analysis revealed moderate to strong correlations. Table 1 shows the mean, standard deviation (SD), and Pearson's correlation coefficient (r) for the NPC-SF six competence areas (CA), the overall NPC-SF score, and the overall B-PAS confidence score after clinical rotation among nurse students ($n=171$).

Further, we used factor analysis to determine whether an overall NPC-SF was reasonable. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.91, exceeding

the recommended value of 0.6 [27]. Bartlett's test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix. Kaiser's criterion and a scree test were examined to determine the number of factors. A one-factor solution was prominent, as the variance explained a decline from 41 to 2% from the first to the second component, and the scree plot showed a clear break after the first component. To aid in the interpretation of the component, a direct oblimin rotation was performed. The component matrix showed a loading above 0.4 for all the items around 1 component. In summary, the calculation of an overall NPC-SF score was suitable, and thus used in the subsequent analyses.

Factors associated with the change in overall NPC-SF

A linear regression analysis was performed to evaluate which factors were associated with the change in the student's nursing competence, with the overall NPC-SF score after clinical rotation as the outcome. The overall B-PAS confidence score and the overall NPC-SF score before clinical rotation, along with the overall usefulness of the Suite of mLearning Tools after clinical rotation, were the variables of interest. In addition, year of education, gender, and age were included as independent variables to adjust for potential confounding factors. The assumption of linearity of the continuous variables was met. No multicollinearity was observed. Results are presented as beta coefficients with 95% confidence intervals (CI).

Validity and reliability

The NPC-SF is validated and has shown good validity and reliability in earlier studies [20, 21]. The reliability of the NPC-SF has been reported as good to excellent with Cronbach's alpha values ranging from 0.71 to 0.86 for all factors [20]. In this study, Cronbach's alpha values ranged between 0.83 and 0.89 for the 6 competence areas measured before the clinical rotation. As shown above, the calculation of an overall NPC-SF score seemed reasonable.

To our knowledge, no validated instrument exists to explore students' perceived confidence in performing a physical assessment, nor to evaluate the usefulness of the Suite of mLearning Tools. It was, therefore, necessary to create study-specify items for the purpose of this study. The confidence items contain four statements related to each examination technique for example: "I am confident that I can inspect correctly when assessing the respiratory system" and tailored the different focus of B-PAS. The same example for the neurological assessment was worded as: "I am confident that I can inspect correctly when assessing the neurological system". A total of 13 items were created, four for the respiratory assessment, three for the peripheral circulation assessment and the heart, four for the abdominal assessment, and two for the neurological assessment (Table 4). The 13 items in the overall B-PAS confidence showed good internal consistency with Cronbach's alpha over 0.9. For the evaluation of the usefulness of the Suite of mLearning Tools eight items were created, seven items evaluated the specific content of the mLearning Tools, and one item evaluated the overall usefulness of the Suite of mLearning Tools (Table 3). Both these sections of the overall questionnaire showed good face validity.

Results

The sample

The characteristics of the students participating in this study are presented in Table 2. Most of the students were female (90%) and Norwegian citizens (84%). A majority (74%) had some work experience before starting their nursing education, 40% of the students had 1 to 5 years of work experience in the healthcare sector. A total of 36 (33%) students in the second year and 6 (6%) students in the third year did not respond to the after clinical rotation questionnaire. Non-responder analysis showed that 81% of the students were female and 79% had working experience. The overall B-PAS confidence score and the overall NPC-SF score before clinical rotation were similar to the responses among students who returned both questionnaires (Supplementary File 5).

The evaluation of the Suite of mLearning Tools at the end of the clinical rotation

The content in the Suite of mLearning Tools was rated higher by the third-year students compared to the second-year students, with a median score ranging from 5.0 to 6.0 and 4.0 to 5.0, respectively (on a 1 to 7 Likert scale; Table 3). The information related to auscultation skills was evaluated highest by both student groups. The third-year students also assessed that the video lectures contributed to increased use of B-PAS. The overall usefulness of the Suite of mLearning Tools was evaluated higher among the third-year students (median 6.0) compared to the second-year students (median 5.0).

Changes in perceived confidence in performing B-PAS

Both the second-and third-year students rated their perceived confidence in performing B-PAS with a mean ranging from 4.0 to 6.1 (on a 1 to 7 Likert scale) and reported similar confidence mean scores at the beginning of the clinical rotation (Table 4). Among the second-year students, only the inspection and palpation related to peripheral circulation assessment reached a small effect size while the percussion related to abdominal assessment reach a moderate effect size. Among third-year students, the changes in perceived confidence reached

Table 2 Characteristics of the two groups of nursing students

	Second-year nursing students *n* = 72 Frequency (%)	Third-year nursing students *n* = 99 Frequency (%)	Total *n* = 171 Frequency (%)
Gender			
Female	67 (93.1)	87 (87.9)	154 (90.1)
Male	3 (4.2)	10 (10.1)	13 (7.6)
Unspecified	2 (2.8)	2 (2.0)	4 (2.3)
Age, years			
≤ 20	32 (44.4)	28 (28.3)	60 (35.0)
21–25	22 (30.6)	32 (32.3)	54 (31.6)
26–30	6 (8.3)	11 (11.1)	17 (9.9)
31–35	6 (8.3)	11 (11.1)	17 (9.9)
36–40	3 (4.2)	7 (7.1)	10 (5.8)
≥ 41	3 (4.2)	10 (10.1)	13 (7,6)
Nationality			
Norwegian	68 (94.4)	75 (75.8)	143 (83.6)
Other	4 (5.6)	24 (24.2)	28 (16.4)
Work experience before enrolling in nursing education			
No work experience	19 (26.4)	26 (26.3)	45 (26.3)
Assistance	22 (30.6)	28 (28.3)	51 (29.8)
Nurse assistance	10 (13.9)	11 (10.1)	21 (12.3)
From different health profession	10 (13.9)	18 (18.2)	28 (16.4)
Not from healthcare services	11 (15.3)	15 (15.2)	26 (15.2)
Years of work experience in the healthcare sector			
≤ 1	33 (45.8)	51 (51.5)	84 (49.1)
1–5	31 (43.1)	37 (37.4)	68 (39.9)
6–10	5 (6.9)	8 (8.1)	13 (7.6)
11–15	3 (4.2)	1 (1.0)	4 (2.3)
Unspecified	0	2 (2.0)	2 (1.2)

Table 3 Evaluation of the individual content and overall evaluation of the Suite of mLearning Tools

Individual content in the Suite of mLearning Tools	Second-year nursing students (*n* = 72)	Third-year nursing students (*n* = 99)
	Mean (*SD*) [Median]	Mean (*SD*) [Median]
Instructional videos contributed to the increased use of the B-PAS[a] in clinical rotation	3.94 (1.64) [4.0]	5.38 (1.27) [5.0]
Video lectures contributed to the increased use of the B-PAS[a] in clinical rotation	4.06 (1.61) [4.0]	5.42 (1.33) [6.0]
Additional information about auscultation of the lungs and heart contributed to increased use of the B-PAS[a] in clinical rotation	4.28 (1.62) [5.0]	5.48 (1.28) [6.0]
Virtual simulation contributed to increased use of the B-PAS[a] in clinical rotation	4.07 (1.64) [4.0]	5.20 (1.55) [5.0]
MOOC[b] contributed to increased use of the B-PAS[a] in clinical rotation	3.57 (1.39) [4.0]	4.61 (1.36) [5.0]
Podcasts contributed to the increased use of the B-PAS[a] in clinical rotation	3.50 (1.37) [4.0]	4.54 (1.40) [5.0]
MCQ[c] contributed to increased use of the B-PAS[a] in clinical rotation	3.97 (1.49) [4.0]	5.14 (1.39) [5.0]
Overall use of the Suite of mLearning Tools contributed to increased use of the B-PAS[1] in clinical rotation	4.39 (1.60) [5.0]	5.73 (1.20) [6.0]

SD Standard deviation

[a] Basic Physical Assessment Skills

[b] Massive Open Online Course

[c] Multiple Choice Questions

Table 4 Students' perceived confidence in performing B-PAS

	Second-year nursing students ($n=72$)			Third-year nursing students ($n=99$)		
	Before clinical rotation	After clinical rotation		Before clinical rotation	After clinical rotation	
The specific B-PAS[a] areas	**Mean (*SD*) [Median]**		***p* value[b] (Cohen's *d*[c])**	**Mean (*SD*) [Median]**		***p* value[b] (Cohen's *d*[c])**
The respiratory assessment						
I am confident that I can inspect correctly when assessing the respiratory system	4.57 (1.22) [5.0]	4.89 (1.22) [5.0]	0.051	4.61 (1.32) [5.0]	5.75 (0.87) [6.0]	< 0.001 (0.93††)
I am confident that I can palpate correctly when assessing the respiratory system	4.32 (1.27) [4.0]	4.82 (1.11) [5.0]	0.002	4.35 (1.37) [5.0]	5.52 (0.91) [6.0]	< 0.001 (1.0)
I am confident that I can percuss correctly when assessing the respiratory system	4.22 (1.25) [4.0]	4.73 (1.06) [5.0]	0.001	4.20 (1.21) [5.0]	5.39 (1.0) [5.0]	< 0.001 (1.2)
I am confident that I can auscultate the lungs correctly when assessing the respiratory system	4.54 (1.18) [5.0]	5.00 (1.10) [5.0]	0.004	4.46 (1.39) [5.0]	5.68 (0.98) [6.0]	< 0.001 (0.99)
The peripheral circulation assessment and the heart						
I am confident that I can inspect correctly when assessing the peripheral circulation	4.90 (1.16) [5.0]	5.53 (0.98) [6.0]	< 0.001 (0.62)	5.35 (1.00) [5.0]	6.09 (0.66) [6.0]	< 0.001 (0.78)
I am confident that I can palpate correctly when assessing the peripheral circulation	4.77 (1.28) [5.0]	5.37 (0.99) [5.0]	< 0.001 0.47	5.28 (0.10) [5.0]	5.97 (0.72) [6.0]	< 0.001 (0.67)
I am confident that I can auscultate the heart correctly when assessing the peripheral circulation	4.30 (1.40) [5.0]	4.79 (1.02) [5.0]	0.005	4.44 (1.42) [5.0]	5.27 (1.20) [5.0]	< 0.001 (0.62)
The abdominal assessment						
I am confident that I can inspect correctly when assessing the abdominal system	4.70 (1.10) [5.0]	4.89 (1.24) [5.0]	0.187	4.79 (1.20) [5.0]	5.70 (0.96) [6.0]	< 0.001 (0.81)
I am confident that I can auscultate the heart correctly when assessing the abdominal system	4.66 (1.22) [5.0]	4.89 (1.21) [5.0]	0.134	4.96 (1.18) [5.0]	5.84 (0.93) [6.0]	< 0.001 (0.79)
I am confident that I can palpate correctly when assessing the abdominal system	4.43 (1.11) [5.0]	4.85 (1.19) [1.19]	0.004	4.78 (1.21) [5.0]	5.66 (0.97) [6.0]	< 0.001 (0.74)

Table 4 (continued)

	Second-year nursing students ($n=72$)			Third-year nursing students ($n=99$)		
	Before clinical rotation	After clinical rotation		Before clinical rotation	After clinical rotation	
The specific B-PAS[a] areas	**Mean (*SD*) [Median]**		***p* value[b] (Cohen's *d*[c])**	**Mean (*SD*) [Median]**		***p* value[b] (Cohen's *d*[c])**
I am confident that I can percuss correctly when assessing the abdominal system	4.10 (1.18) [4.0]	4.58 (1.15) [5.0]	< 0.001 (0.48)	4.53 (1.23) [6.0]	5.40 (1.05) [6.0]	< 0.001 (0.71)
The neurological assessment						
I am confident that I can inspect correctly when assessing the neurological system	4.33 (1.07) [5.0]	4.50 (1.26) [5.0]	0.319	4.46 (1.31) [5.0]	5.32 (1.02) [5.0]	< 0.001 (0.64)
I am confident that I can palpate correctly when assessing the neurological system	4.01 (1.19) [4.0]	4.27 (1.26) [4.0]	0.111	4.28 (1.30) [5.0]	5.30 (0.96) [5.0]	< 0.001 (0.73)
The overall B-PAS[a] confidence score[d]	63.6 (13.3) [65.9]	69.4 (12.2) [71.4]	< 0.001 (0.40)	66.5 (14.2) [67.0]	80.1 (10.1) [81.3]	< 0.001 (1.2)

[a] Basic Physical Assessment skills

[b] *p* value from paired sample t-test, considered statistically significant if < 0.001

[c] Cohen's *d* interpreted as moderate effect size if > 0.5 and large effect size if > 0.8

[d] Values for the overall confidence scores ranged from 1 to 100, where 100 corresponds to the highest level of perceived confidence

significantly moderate to large effect sizes within all the B-PAS areas, with the lowest confidence score being related to auscultating the heart. Changes in the overall B-PAS confidence score were statistically significant in both student groups, but only clinically significant among the third-year students (effect size > 0.8). The correlation matrix in Table 1 also shows how the overall B-PAS confidence score correlated with all 6 competence areas and the overall NPC-SF score after clinical rotation.

Changes in nursing competence

The difference in the students' responses before and after one clinical rotation reached statistical significance in all six competence areas (Table 5). The changes were measured as moderate or large in all areas in both student groups, with the largest effect size (> 0.8) being related to Nursing Care, and Medical and Technical Care. The second-year students reported the lowest moderate change (> 0.53) within the area of Development, Leadership, and Organization of Nursing Care, whereas the third-year students reported the lowest moderate change (> 0.72) related to Care Pedagogics. The change in overall NPC-SF score from before to after clinical rotation was statistically and clinically significant in both student groups.

Factors associated with the change in the overall nursing competence

Univariable linear regression analyses showed positive associations between the individual variables and the overall NPC-SF score after clinical rotation (Table 6).

Multivariable linear regression analysis, also adjusted for year of education, gender, and age, revealed consistent results. Students reporting a high overall NPC-SF score before clinical rotation had a higher overall NPC-SF score after clinical rotation; for each unit increase in the "before" score, the average increase in the "after" score was 0.4 (95%, *CI* 0.3–0.5). A positive association was also observed between the overall B-PAS confidence score and the overall Suite of mLearning Tools evaluation score (understood as the degree of the usefulness of the Suite of mLearning Tools). Hence, among the students reporting a high overall B-PAS confidence score and high overall usefulness of the Suite of mLearning Tools, the higher the self-reported overall NPC-SF score was after the clinical rotation (Table 6). The adjusted R^2 showed that the regression model explained 42% of the variance in the overall NPC-SF score after clinical rotation.

Table 5 Nursing students self-reported changes within the six competence areas before and after one clinical rotation

NPC-SF Competence areas		Second-year students ($n=72$)			Third-year students ($n=99$)		
		Before clinical rotation	After clinical rotation	p value[b] (Cohen's d[c])	Before clinical rotation	After clinical rotation	p value[b] (Cohen's d[c])
	Cronbach's alpha[a]	Mean (*SD*)			Mean (*SD*)		
Nursing Care	0.84	67.9 (10.93)	77.2 (10.84)	< 0.001 (0.89)	77.5 (9.02)	85.0 (8.05)	< 0.001 (0.82)
Value-Based Nursing Care	0.80	79.4 (10.28)	86.6 (8.65)	< 0.001 (0.64)	83.9 (9.55)	89.6 (8.26)	< 0.001 (0.74)
Medical and Technical Care	0.83	66.6 (10.43)	78.7 (9.83)	< 0.001 (1.0)	76.4 (9.77)	84.7 (8.37)	< 0.001 (0.88)
Care Pedagogics	0.87	64.4 (12.35)	75.2 (10.80)	< 0.001 (0.76)	73.2 (11.60)	80.7 (9.91)	< 0.001 (0.72)
Documentation and Administration of Nursing	0.86	72.7 (10.36)	80.6 (9.40)	< 0.001 (0.77)	78.9 (9.62)	86.0 (8.10)	< 0.001 (0.76)
Development, Leadership, and Organisation of Nursing Care	0.87	57.8 (13.56)	66.1 (12.41)	< 0.001 (0.53)	66.2 (10.97)	74.6 (11.22)	< 0.001 (0.74)
The overall NPC-SF score[d]	0.96	68.2 (9.29)	77.4 (8.34)	< 0.001 (1.01)	76.0 (8.54)	83.5 (7.46)	< 0.001 (1.02)

SD = standard deviation and NPC-SF = Nurse Professional Competence scale Short Form

[a] Cronbach's alpha measured after clinical rotation

[b] p value from the paired t-test, considered statistically significant if < 0.001

[c] Cohen's d interpreted as moderate effect size if > 0.5 and large effect size if > 0.8

[d] Values for the overall NPC-SF score ranged from 1 to 100, where 100 corresponds to the highest level of self-reported competence

Table 6 Univariable and multivariable linear regression analysis of factors associated with the overall NPC-SF score after clinical rotation ($n=171$)

	Univariable analysis			Multivariable analysis		
	Coefficient	95% *CI*	p value	Coefficient[a]	95% *CI*	p value
Overall B-PAS confidence score before clinical rotation[b]	0.20	0.11, 0.29	< 0.001	0.10	0.03, 0.18	0.008
Overall usefulness of the Suite of mLearning Tools[c]	1.94	1.16, 2.71	< 0.001	0.80	0.09, 1.52	0.028
Overall NPC-SF score before clinical rotation[b]	0.52	0.42, 0.63	< 0.001	0.40	0.28, 0.52	< 0.001

CI Confidence interval, *B-PAS* Basic physical assessment skills, and *NPC-SF* Nurse professional competence scale short-form

[a] Multivariable linear regression coefficients adjusted for all covariates including year of education, gender, and age

[b] Scores range from 1–100 where higher scores indicate higher self-reported confidence or nursing competence

[c] Scores range from 1–7 where higher scores indicate better evaluation of the Suite of mLearning Tools

Discussion

This study contributes three main findings. First, confidence in performing B-PAS is an important aspect of students' overall nursing competence, and of all six competence areas defined by NPC-SF. Second, voluntary use of the Suite of mLearning Tools contributed to change in overall nursing competence by supporting increased use of B-PAS. And third, overall nursing competence increased significantly after clinical rotation in the second and third educational years. These findings will be discussed with regard to the FoC Framework and relevant empirical studies.

Confidence in B-PAS is important for overall nursing competence

This study is unique in its investigation of students' perceived confidence specifically related to performing all four examination techniques in B-PAS—*inspection*, *palpation*, *percussion*, and *auscultation*—in second and third educational years. Working with B-PAS requires professional knowledge from human bioscience topics like anatomy and pathophysiology, which underpin appropriate clinical reasoning processes [28]. Based on the findings, B-PAS can be considered a pillar of person-centered care, as proposed by the FoCFramework, and

an important element in nursing competence. We found moderate to high correlations between all six competence areas of the NPC-SF and overall B-PAS confidence score (Table 1). The multivariable regression analysis also showed a positive association between overall B-PAS confidence score and overall NPC-SF score after clinical rotation. The higher students rated their confidence in performing B-PAS, the higher their overall NPC-SF score. This highlights the importance of focusing on how to support students in becoming a) competent in the different areas of nursing care during their clinical rotation, and b) confident in using B-PAS.

Low student confidence, lack of role models and time, interruptions, and area of specialty in clinical rotations are identified as common barriers to using B-PAS in patient care [8, 9]. These findings correspond to Byermoen et al. [29], who investigated barriers and facilitating factors for students' use of B-PAS in clinical rotation. Douglas et al. [8] also showed that low student confidence is associated with low utilization of B-PAS in clinical rotation. This indicates that students need to be supported, supervised, and challenged in using B-PAS by preceptors and other members of the clinical rotation. Lack of confidence in performing these assessment skills increases the risk of not being able to adequately identify patient care needs and select appropriate nursing interventions. It can also negatively affect student–patient relationships and hinder the integration of high-quality nursing care. Interestingly, the overall B-PAS confidence score statistically significantly correlated with all NPC-SF competence areas—not just with Medical and Technical Care. Moreover, findings suggest that confidence in performing the B-PAS is regarded as an essential element in Value-Based Nursing Care and Nursing Care. Thus, we argue that using B-PAS systematically in clinical rotations is crucial skills to provide person-centered fundamental care.

The students rated their confidence in performing B-PAS higher after the clinical rotation in the third educational year than students in the second. This may be explained by the natural development of increased confidence during education through more clinical exposure, training with peers, and increased knowledge. However, it is also relevant to examine in which areas of healthcare service the students were placed. The literature highlights that contextual factors could be potential barriers to students' use of B-PAS [8, 9, 29]. Clinical rotation contexts at our university represent different foci in the two educational years: medical/surgical nursing care in hospitals in the second year and home-based nursing care in the third. Within hospital settings, physical assessments are routinely performed by medical doctors at admission, who are also available for consultation and follow-up in the clinical situation. The second-year students completing their clinical rotation in hospitals reported a small change in overall B-PAS confidence (Cohen's $d = 0.4$). In home-based nursing care, however, assessments of clinical situations and patient care needs are typically performed more independently by nurses. Third-year students completing clinical rotations in this context reported a large change in overall B-PAS confidence (Cohen's $d = 1.2$). These findings may indicate that the preceptors in home-based nursing care acknowledge B-PAS as valuable skills in the "toolbox" of nurses' health assessment and identification of patient care needs. It might therefore be less intimidating for home-based nursing care students to initiatethe use of B-PAS than for students in the hospital setting [29].

The RNs' skill in performing B-PAS themselves is worth considering. As the introduction of these skills into the curriculum at our university commenced in 2015 [11], many preceptors might still lack confidence needed to successfully integrate B-PAS as a routine in their daily practice. This may arguably limit their supervision around applying and modeling these skills in clinical contexts. Consequently, students might be reluctant to initiate and use B-PAS for fear of disturbing their relationship with their supervisors [8, 9, 29]. We propose that managers should prioritize postgraduate training for their nurses to strengthen their skills to facilitate students' learning of B-PAS to be confidently practiced and recognized as an essential part of person-centered nursing care. Students would thus benefit from learning and using B-PAS in authentic clinical situations across different healthcare contexts contributing to the growth of confidence and safe learning experiences with peers preceptors, and other health professionals.

Digital learning resources support the learning of B-PAS

In the multivariable regression analysis, the usefulness of the Suite of mLearning Tools was positively associated with the overall NPC-SF score. This indicates that these digital learning resources supported the students' development of assessment skills as nursing competence during clinical rotations.. Ewertsson et al. [14] highlighed that learning practical skills requires frequent training. The spaced repetition underpinning the Progression Model introduced by Egilsdottir et al. [11] offers a pedagogical approach that can help students build confidence by organizing supervised training with peers and faculty throughout their nursing education. This pedagogical approach is supported by Ewertsson et al. [14] and Kang [12]. Moreover, access to different digital learning resources—for example, the Suite of mLearning Tools—creates hybrid learning spaces that help minimize

barriers to using B-PAS as well as reducing the "theory–practice gap" [15, 29].

Findings show variation in how students in the different educational years evaluated the usefulness of the Suite of mLearning Tools (Table 3). The third-year students considered the digital learning resources useful for supporting B-PAS when in clinical rotation (median score 5.0–6.0); the second-year students were more insecure in their responses (median score 4.0–5.0). This may reflect different uses of the Suite of mLearning Tools and indicate that the second-year students might not have taken as much advantage of the digital learning resources as the third-year students. These differences in students' responses further suggest that contextual factors may influence students' application of B-PAS in clinical rotations. Ewertsson et al. [14] highlight the "situated power" nurses have in clinical contexts, which significantly influences how and what students choose to practice when in clinical rotation.

Changes in nursing competence in different phases during nursing education

Our results show that self-reported competence increased after clinical rotation in second-and third-year students. However, third-year students rated their competence at the *beginning* of their clinical rotation similarly to second-year students' rating at the *end* of their clinical rotation. This indicates that they continued to experience improvement in their level of competence between the second and third educational years. As in other studies [21–23], students in both educational years rated their competence highest in Value-Based Nursing Care. It has been argued that Value-Based Nursing Care is underpinned by person-centered care values, which has also been associated with increased standards and quality of fundamental care [16]. Interestingly, the students scored high on their Value-Based Nursing Care competence which might indicate that the students had developed qualities in line with person-centered care practices. Two other competence areas where the students in this study assessed themselves as highly competent were Nursing Care and Medical and Technical Care (Cohen's $d > 0.8$). These competence areas are also components of the FoC-Framework suggesting that the characteristics and foci of the learning situations in which the students are engaged during clinical rotations center around the patients and their families. Hence, these results indicate that the students in this study evaluated themselves as highly competent in providing person-centered fundamental care, as suggested by the FoCFramework.

The competence areas within the NPC-SF where the students in both groups assessed themselves as least competent were the Development, Leadership, and Organization of Nursing Care. These results are comparable to other studies [21–23]. Worth noting is that these studies include only students at the point of graduation, not in other educational years, as in the current study. This highlights the need to review the extent to which learning outcomes related to these areas are appropriately covered in nursing education and clinical rotation. Identifying suitable learning situations in clinical practice can also promote learning related to these competence areas.

Some questions in the NPC-SF competence areas can be viewed as the operationalization of recommendations to establish a therapeutic relationship, as proposed by Feo et al. [18]. These questionscan capture students' application of the Fundamentals of Care in clinical rotations, the student (nurse)–patient relationship, as well as the skills' integration of care. The NPC-SF can further be used as an outcome measure, as in the current study when students self-assessment demonstrate highly competent within all areas the questionnaire captured.

Limitations

Study results reports the nursing students' subjectively experienced changes in nursing competence and confidence. Therefore, limitations of self-reported data must be taken into consideration. Participants may score or rate themselves according to an ideal, or their self-regard, rather than their actual performance or behavior [30]. There is also a possibility that participants rated their competence according to what was expected of them related to being a student in the second or third educational year. Furthermore, the measurement of confidence in B-PAS and the evaluation of the Suite of mLearning Tools must be interpreted with caution since these questionnaires have not been validated. Although the supervision model was the same for all clinical rotation sites, it is possible that the preceptors might have had variable experience of using B-PAS, which could have influenced the student perceived confidence. As perceived confidence in B-PAS is shown to be an important aspect of fundamental care in this study; future studies should validate the questionnaire to establish how well the questionnaire captures actual confidence in and its relation to other competence areas. Due to this, the explorative nature of the study and as the participants represent only two cohorts at one university, the generalizability of the study's results is limited. Moreover, it would have also been actual to compare individual students' use of the Suite of mLearning Tools related to their evaluation of the usefulness of the tools. This was not possible in the current study because of the General Data Protection Regulation.

Conclusion

The findings in this study is that confidence in performing B-PAS is an important component of nursing competence and in fundamental care. Further, the positive association between reported confidence in B-PAS, the usefulness of the Suite of mLearning Tools, and changes in nursing competence suggest that learning opportunities could improve skills, competence, and also confidence. Spaced repetition and access to digital learning resources may offer a way to enhance skills learning and personal growth. The students' reporting related to different areas of nursing competence measured with the NPC-SF showed adequate levels of fundamental person-centered care practices. In the context of FoC, the students' confidence and nursing competence can have positive or negative consequences on the student–patient relationship and the integration of care processes. The influences of contextual factors suggest a need for stakeholders from academia, clinical practice, and students to explore together how the acquisition of B-PAS can be integrated better into daily practice. In this way, confidence will be strengthened for nurses and students, emphasizing the benefits of the B-PAS as a component of the assessment "toolbox" for nursing practice.

More research is needed to explore in-depth the association between perceived confidence and competence, and how to stimulate the successful transfer of skills between different learning contexts in nursing education. Furthermore, it would be useful to explore and compare the actual frequency of B-PAS use among the students in both home-based nursing care and medical/surgical clinical rotations.

Abbreviations

B-PAS	Basic Physical Assessment Skills
FoC	Fundamentals of Care Framework
NPC-SF	Nurse professional competence scale short form
CI	Confidence intervals
mLearning	Mobile Learning
SD	Standard Deviation
CA	Competence Areas

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-023-04078-7.

Additional file 1: Supplementary File 1. Basic Physical Assesment Skills (B-PAS) in the bachelor nursing program.

Additional file 2: Supplementary file 2. Overview of the six competence areas in NPC-SF and the main focuses within each area.

Additional file 3: Supplementary file 3. STROBE Statement—Checklist of items that should be included in reports of cohort studies.

Additional file 4: Supplementary File 4. Suite of mLearning Tools.

Additional file 5: Supplementary File 5. Characteristics of the two groups of nursing students that didn't return the post-questionnaire.

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Authors' contributions

HÖE*: conceptualization, study design, methodology, recruitment of participants, data management, data analysis and interpretation, drafting, editing, writing, and revising the manuscript. LGH: conceptualization, study design, editing, and revising the manuscript. RSF: study design, data analysis and interpretation, editing and revising the article. EAB: conceptualization, study design, editing, and revising the manuscript. KRB: conceptualization, study design, editing, and revising the manuscript. AM: conceptualization, study design, drafting, editing, writing, and revising the manuscript. HE: conceptualization, study design, methodology, data analysis and interpretation of data, drafting, editing, and revising the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The quantitative metadata used and analysed in this study are available on request to the corresponding author, H.Ösp Egilsdottir.

Declarations

Ethics approvals and consent to participate

The Norwegian Centre for Research Data (NSD) approved every aspect of the study, including the consent procedure (Project No. 674624). According to the national regulations, further approval from a medical ethical committee was not necessary since no patients are involved, and the study regards students ´learning. The Faculty of Health and Social Sciences at the actual university also approved the study. All participants were informed about confidentiality, the voluntary nature of participation, the possibility to withdraw from the study at any time, and information on how the research data would be saved and deleted at the end of the research period. Informed consent was obtained.

The methods in the study are carried out in accordance with relevant guidelines and regulations. The STROBE guidelines for cohort studies were followed for study reporting (Supplementary File 4).

Consent for publication

Not applicable.

Competing interests

There is no conflict of interest to disclose.

Author details

[1]Centre for Health and Technology, Faculty of Health and Social Sciences, Institute for Nursing and Health Sciences, University of South-Eastern Norway, Grønland 58, 3045 Drammen, Norway. [2]Oslo Centre for Biostatistics and Epidemiology, Oslo University Hospital, Oslo, Norway. [3]Faculty of Health and Social Sciences, Institute for Nursing and Social Sciences, University of South-Eastern Norway, Grønland 58, 3045 Drammen, Norway. [4]Institute for Health and Society, Faculty of Medicine, University of Oslo, Forskningsveien 2B, 0371 Oslo, Norway.

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Publisher's Note

Paper 4

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RESEARCH

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The value of a redesigned clinical course during COVID-19 pandemic: an explorative convergent mixed-methods study

H. Ösp Egilsdottir[1*], Lena Günterberg Heyn[1], Espen Andreas Brembo[1], Kirsten Røland Byermoen[1], Anne Moen[2] and Hilde Eide[1]

Abstract

Background: The COVID-19 lockdown in March 2020 had a significant consequence for nursing students worldwide including limited access to learning situations in clinical rotation. Therefore, this study aims to explore how an innovative redesign of a clinical course in a time of pandemic supported nursing students in learning the fundamentals of care in their first year. The redesign involved the transformation of a traditional hands-on clinical course into a technology-enhanced learning environment.

Design: This was an explorative convergent mixed-methods study using both quantitative and qualitative methods.

Methods: Twenty-four first-year nursing students responded to an online questionnaire with open-ended questions. Two nursing students and one faculty member participated in individual online interviews, and three faculty members participated in an online focus group interview. All the data were collected in June 2020. The quantitative data were analyzed using descriptive statistics and the qualitative data using content analysis. The GRAMMS guideline was applied.

Results: The students achieved the learning outcomes regarding fundamental care, basic physical assessment skills, and clinical reasoning with the help of academic assignments, multimedia learning resources, and virtual patients. Further, six central aspects of the facilitator role in the virtual simulation were identified. The aspect that was considered most valuable involved uncovering the "red thread" between different areas of knowledge in the first year of nursing education; this supported the students to better understand how to think and talk like a nurse.

Conclusion: This study offers insight into how a technology-enhanced clinical course can foster the learning of fundamental nursing care, basic physical assessment skills, and clinical reasoning skills; enhancing students' preparedness for clinical hours. Virtual patients' scenarios contributed to integrating different types of knowledge and skills that are important when providing nursing care for patients in clinical practice. This study also highlighted a gap in pedagogical competence among faculty members with regards to facilitating learning in a technology-enhanced learning environment. Study findings suggest promising pedagogical strategies that should be further developed post-pandemic, in response to the call for a renewal of nursing education using more technologically supported learning designs.

*Correspondence: osp.egilsdottir@usn.no
[1] Centre for Health and Technology, Faculty of Health and Social Sciences, University of South-Eastern Norway, Grønland 58, 3045 Drammen, Norway
Full list of author information is available at the end of the article

Keywords: Nursing, Student nursing, Education, clinical, Computer simulation, Clinical competence, Nursing skills, Education nursing, Clinical reasoning

Background

In the spring of 2020, the COVID-19 pandemic resulted in global service disruptions, including lockdowns, shifting teaching, and learning to online platforms and a technology-enhanced approach [1, 2]. As many nursing curriculums mandate that 50% of student education takes place in clinical rotation [3], the pandemic had significant consequences for nursing students around the world. While some learning activities (e.g., lectures, discussions groups, and supervisions) were easily facilitated through online platforms, other learning activities (e.g., simulation and clinical skills training) were not well-suited to online facilitation. Access to learning situations in the clinical rotation was also very limited.

Given the above, and inspired by the Technological, Pedagogical, and Content Knowledge (TPACK) framework [4], we redesigned a first-year clinical course into a technology-enhanced learning environment focused on fundamental care, such as health assessment, clinical skills, and nursing interventions. A suite of mobile learning (mLearning) tools previously reported on in an earlier study [5] was introduced as the main content in the redesigned clinical course (RCC) to replace real-life patient encounters and clinical experiences with e.g. virtual patients and instructional videos. The current paper describes the RCC in detail and the students' and faculty members' experiences of participating in the course.

Fundamental care and basic physical assessment skills (B-PAS)

The clinical rotation represents an important learning environment for nursing students to practice fundamental care and clinical skills [6, 7]. Feo et al. [8] have defined what constitutes fundamental care:

> *Fundamental care involves actions on the part of the nurse that respect and focus on a person's essential needs to ensure their physical and psychosocial wellbeing. These needs are met by developing a positive and trusting relationship with the person being cared for as well as their family/careers (p.2295)*

Kitson et al. [6] question whether the nursing profession has lost sight of how to value and view caring as a fundamental aspect of nursing, with the increased focus in modern nursing practice on cost-effectiveness, task orientation, and outcomes of care rather than how the care itself is provided. The authors offer a new vision for professional nursing practice and highlight the importance of fundamental care by introducing a conceptual framework: Fundamentals of Care (FoC). The FoC framework revolves around the nurse, patient, family, and context or health system in a multidimensional way [6]. Moreover, it focuses on how the nurse and the patient collaborate through a meaningful therapeutic relationship towards assessment, planning, implementing, and evaluating care related to fundamental care needs [6].

Health assessment with the integration of a wide range of physical assessment skills is an acknowledged core dimension of fundamental care [9]. The process of health assessment is closely linked to cognitive skills in nursing, including clinical reasoning and decision-making. The use of cognitive skills is grounded in pillars of professional knowledge, such as human bioscience knowledge (anatomy, physiology, pathophysiology, and pharmacology), fundamental nursing care, ethics, professional communication, and nursing documentation. However, newly graduated nurses lack confidence and competence in using all the physical assessment skills learned throughout their education, due to lack of role clarity [9] and lack of support and guidance from preceptors in clinical rotations [10, 11]. This may increase nurses' resistance to using this core component of health assessment, which may reduce the likelihood that fundamental care needs being identified and met with appropriate nursing interventions [12].

Ideally, the range of physical assessment skills should be limited to what are considered the basic elements of physical assessment skills performed by a nurse, regardless of context [11, 13]. Therefore, a selection of physical assessment skills was chosen to be included in the basic physical assessment skills (B-PAS) curriculum [11]. Further, to provide a digital support for nursing students practicing B-PAS in clinical rotation, a Suite of mLearning tools were co-designed with nursing students from different educational years [5].

Learning from virtual patient encounters and virtual simulation

A recent comprehensive systematic review identified the use and effect of virtual patients on student learning in health care educations [14]. Findings indicate that virtual patients are at least as effective as traditional education learning activities for knowledge outcomes, while the use of virtual patients seems to be more effective for skills outcomes [14].

Virtual patients are mediated through standardized computer software programs; students interact with the software by e.g. choosing different actions to communicate with the virtual patient, map the clinical situation, initiate fundamental care actions, administer medications, and consult a physician [14, 15]. The literature outlines a variety of methods for exploring students' learning experiences related to using multimedia learning material and virtual patients, as well as methods for measuring learning outcomes. These learning outcomes mainly center around clinical reasoning skills, clinical decision-making, critical thinking, knowledge retention, communication, clinical skills performance, and students' perceived confidence. Among the learning experiences explored in the literature are students' satisfaction, attitudes, and technology-related concerns [14, 15].

Kononowicz et al. [14] point out that virtual patients can have a greater impact on knowledge outcomes when combined with the application of skills, particularly in problem-solving situations. Furthermore, virtual patients may also be a modality for learning clinical reasoning and critical thinking prior to clinical rotations, in order to prepare students for clinical hours [14]. Foronda et al. [15] reviewed the literature when mapping the use of virtual simulation (which includes virtual patients) in nursing education and found that this type of simulation improved student learning outcomes (knowledge, skills, satisfaction, critical thinking, and self-confidence) in 86% of the included studies ($N=80$). More time spent on virtual simulation (virtual patients) correlated with increased benefits for learning. However, there was limited information concerning the time needed to achieve the described learning outcomes. Moreover, the feasibility and strength of the virtual patient scenarios appears rooted in the opportunity to repeatedly train clinical skills and clinical reasoning by re-visiting the same virtual patient scenario and re-assessing the clinical situation [16, 17]; in doing so, the students also continue refining their communication and history-taking skills [17].

The use of virtual patients in health care education can help standardize learning situations in clinical courses: this is beneficial both for ensuring that students have similar clinical learning experiences and thus preparedness for patient care, and helping them make up for lost clinical hours [14, 17, 18]. Georg and Zary [19] conceptualized how virtual patients can increase nursing students' preparedness for clinical practice and clinical reasoning skills. In their work, the core aspects of the nursing role and fundamental care are mirrored in the utility of virtual patients in educational practice. Georg and Zary [19] also show how the virtual patient can be integrated into course design to highlight clinical reasoning skills based on feedback from faculty members, to identify the level of students' knowledge and knowledge gaps. Further, Deschênes et al. [20] highlight how technology advancements can inform education strategies for learning clinical reasoning skills. In their findings, providing students with feedback based on a Socratic approach to questioning and modeling clinical reasoning skills supports students to understand what is involved in these cognitive processes and how to apply them in real patient encounters [20].

Pedagogical perspectives to support the development of technology-enhanced courses

The TPACK framework offers a structure and context that describes the relationship and interaction between the three domains of technology, pedagogy, and educational content [4]. Every course design is a unique process, in which the interactions between these three domains will unfold differently [4]. Using a pedagogical framework to inform and support the integration of technology and pedagogy can help both faculty members and students to understand the purpose, aim, and learning outcomes in this kind of course design [7]. Increased use of technology-enhanced pedagogy in higher education indicates a transition from a teacher-centered approach towards a more student-centered and interactive approach [21, 22]. Six key factors are important to keep in mind when designing technology-enhanced courses: 1) the didactical competency for the design of suitable learning material to secure alignment with learning outcomes; 2) scaffolding student workload; 3) facilitating asynchronous learning processes; 4) student–faculty communication; 5) student–student communication, and 6) organizing support for students in how to use the different technical components in a technology-enhanced learning environment [2, 21].

Technology-enhanced learning material used in clinical rotation can support the learning of clinical skills and increase knowledge levels and students' perceived confidence [7, 23]. Chuang et al. [23] found that using an instructional video delivered through a smartphone to support a specific clinical skill had a significant effect on students' knowledge and performance of the skill compared to the control group (which was not given the instructional video). Furthermore, Stone et al. [7] reviewed the effect of podcast and multimedia materials on students' level of knowledge, skills performance, satisfaction, and confidence: multimedia learning material seemed to have a greater impact on these learning outcomes for students in the lower grade range than those with higher grades.

Our review of the existing research revealed studies using multimedia learning material or virtual patients, or virtual simulation aimed for clinical learning. No studies

were found that combined these learning activities as a substitution for a traditional clinical rotation or as a complementary learning activity in a clinical course. More evidence is therefore needed that provides insight into how these technological components can be combined to support students' learning and utilizing of professional knowledge, clinical reasoning, and clinical skills, such as B-PAS.

Methods

Aims

This study aimed to explore how an RCC supported nursing students in learning fundamental care in their first educational year. Four research questions were formulated:

1) How much time did the nursing students spend using the available learning activities?
2) What was the nursing students' self-reported confidence related to the B-PAS in the RCC?
3) What characterized the learning experiences in virtual patient encounters?
4) Which learning experiences did the nursing students and faculty members perceive as most prominent in the RCC?

Design

An explorative, convergent mixed-methods study was designed, using a questionnaire and interviews (individual and focus group) to collect data from students and faculty members (Fig. 1). A convergent design aims to collect different independent and complementary data about a specific research problem [24]. Hence, the data collection processes are not dependent on each other but rather carried out concurrently, as in this study. Creswell and Plano Clarke [24] argue that convergent design strengthen a research project by exploring the aim and the research questions from different perspectives. This was considered essential in this study, and was achieved by using two complementary research methods and exploring the study aim from the perspective of both students and faculty members.

The redesigned clinical course

The point of departure was the curriculum for a 10-week clinical rotation course with specific learning objectives targeting aspects of fundamental nursing care, such as communication skills, learning systematic health assessment, and person-centred care for older patients and their families [25]. The content of the clinical course before the redesign is shown on the left side, in Fig. 2.

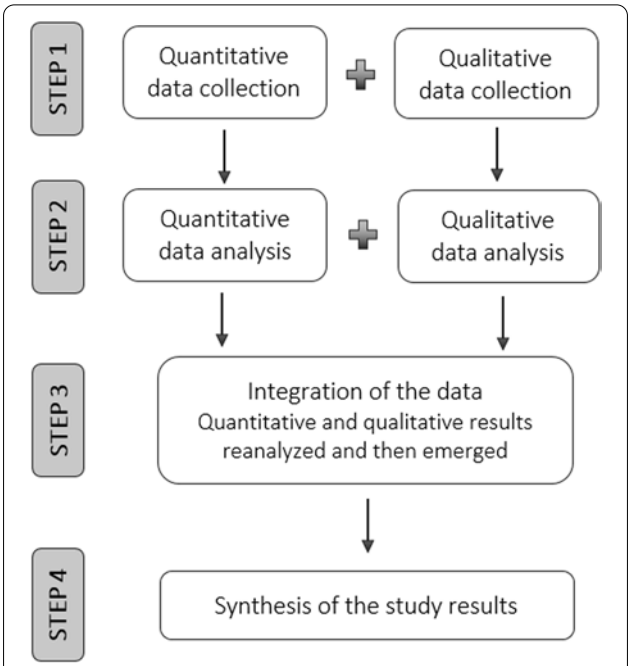

Fig. 1 The explorative convergent mixed-methods design used in the study. Figure adapted from Creswell and Plano Clark (2018), p. 70

We began the redesign by assessing how the students could reach learning objectives in a technology-enhanced learning environment, by combining a Suite of mLearning tools [5] with traditional academic assignments (for an overview of the course content, see Fig. 2, right side). The following areas were prioritized: 1) taking the patient history, 2) learning B-PAS, 3) the health assessment, 4) communication skills, 5) fundamental nursing care and interventions, 6) human bioscience knowledge, and 7) clinical reasoning skills.

The RCC also included multiple digital interactions between the supervising faculty members and the nursing students. A commercial video conferencing system (CVCS) was used as a digital platform. The activities mediated through the CVCS involved different foci for supervision, student progress assessment, feedback on academic assignments, general student support, and the simulation with the virtual patient scenarios. The encounters in the CVCS were also an opportunity for faculty members to help students navigate the different learning activities, and to encourage them to use all available digital learning resources scaffolded through the 10-week RCC.

The simulation with virtual patients was conducted four times throughout the 10 weeks (Fig. 3). The selection of the virtual patient scenarios was based on the primary assessment approach: Airways (A), Breathing (B), Circulation (C), Disability (D), and Exposure (E) (ABCDE).

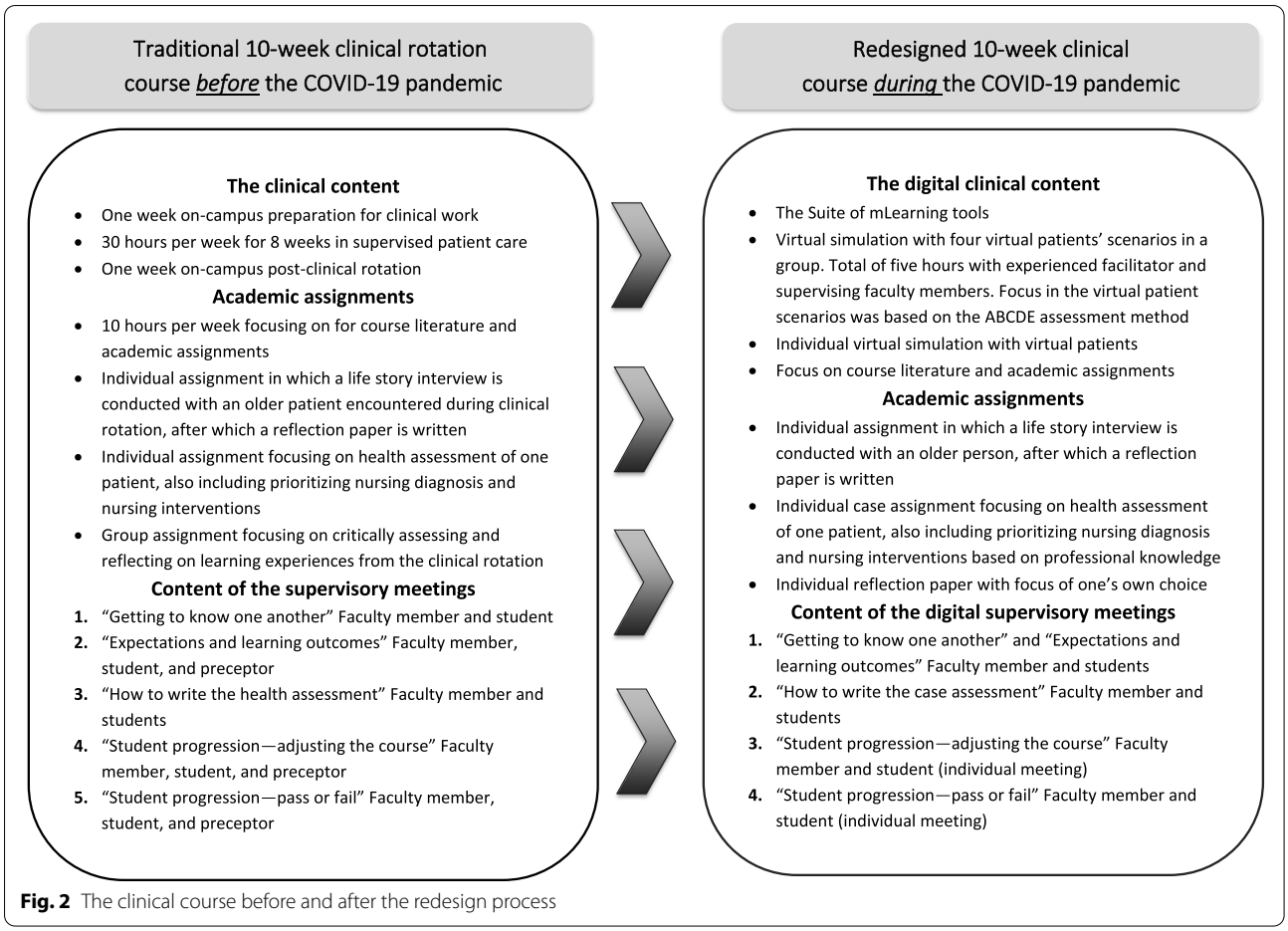

Fig. 2 The clinical course before and after the redesign process

The four virtual simulation sessions were organized as shown in Table 1.

The same experienced facilitator was responsible for all four sessions and had access to the virtual simulation program via computer (Table 1). By sharing the screen, all the participants could see and hear everything happening in the virtual patient scenario. In addition, the faculty members responsible for supervising the nursing students also participated in the virtual simulation sessions. Their role was to contribute to the ongoing discussions and give advice to the students in their encounters with the virtual patient. This involvement gave the faculty members a unique opportunity to follow up on specific elements later in the supervisory meetings with students. The facilitator executed all the actions throughout the simulation. The students who had an active role in the simulation session decided together which actions to take. The facilitator paused the simulation whenever it was pertinent to explore relevant professional knowledge underpinning the actions and clinical reasoning, by using interrogative words like "why," "how" and "what." The students were continuously encouraged and stimulated to verbalize their knowledge, reflections, and ideas throughout the session with the facilitator, participating faculty member, and fellow students. The students were also advised to use any types of aids, course literature, online resources, or active reflections with peers.

In addition, the RCC included mandatory academic assignments (Fig. 2, right side). The aim of the assignments was the same as in the traditional clinical rotation course, with a few adjustments. A life story interview was conducted via telephone instead of face-to-face. The nursing students could choose whom to interview, as long as it was an older person. All the students received the same patient case as a starting point for the case assignment; further, they each submitted the assignments individually and were rated pass/fail by the supervising faculty member. The researchers involved in the study had no role in the evaluation or rating of the students' assignments.

The redesign process also included exploration of what could constitute as a patient encounter in a technology-enhanced clinical course. This process led us to suggest that the following elements could be viewed as patient

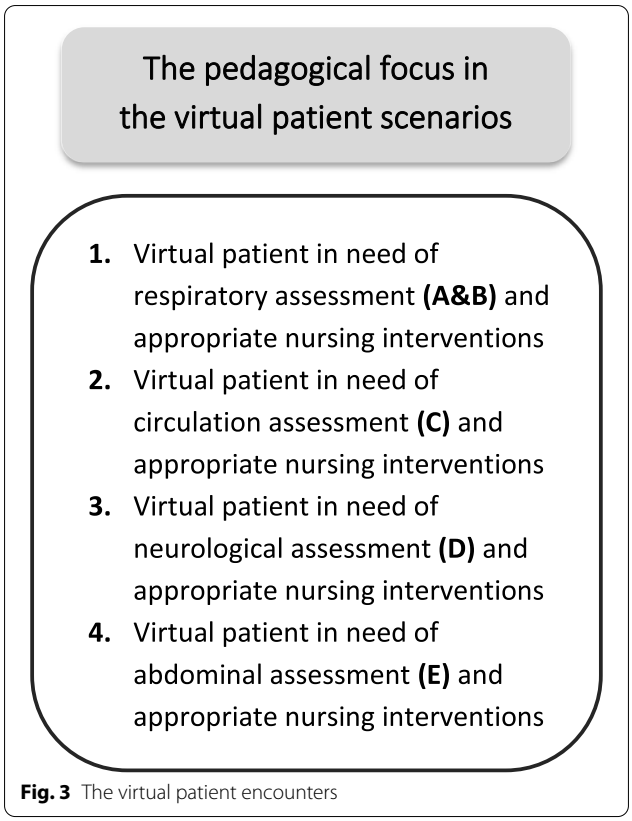

Fig. 3 The virtual patient encounters

encounter: the virtual patients, the case assignment, the life story interview, instructional videos and a selection of assignments in the Massive Open Online Course (MOOC) which were available in the Suite of mLearning tools [5].

Participants

The participants in the study were first-year nursing students enrolled in a three-year bachelor program and program faculty members, all at the same university in Norway. All nursing students registered in the RCC ($N=55$) were invited to participate in both the quantitative and qualitative parts of the study. The students received written and oral information (via a video presentation) about the study through the university's learning management system (LMS). Upon completion of the 10-week RCC, the students were invited to answer the questionnaire and to participate in the interviews.

Twenty-four nursing students agreed to participate and answered the study-specific questionnaire (41.8% response rate). All but one was female. Thirteen students provided textual feedback about the strengths and weaknesses of the RCC, and two female students participated in the online individual interviews. The majority of the students (54.2%) were younger than 24 years of age (Table 2).

At the end of the RCC, all faculty members who were responsible for the supervision of the students in the RCC ($N=16$) received oral (via CVCS) and written information about the study and an invitation to participate in the qualitative interviews. Three faculty members participated in the online focus group interview and one was interviewed individually online. All the faculty members were females, ranging in age from 47 to 60 years.

Data collection

All the data were collected at the beginning of June 2020, just after the completion of the 10-week RCC. The student questionnaire, which also included open-ended questions, was administered concurrently with the qualitative interviews with students and faculty.

The student questionnaire

For this study, a 62-item questionnaire divided across 11 sections was developed. The questionnaire was not validated prior to its use. In section 2, the students were asked to estimate the time spent on each learning activity per week in the RCC. For items in sections 3 to 10 (see Tables 5, 6, 7, 8 and 9), a 5-point Likert scale was applied with the following options: "disagree," "disagree a little," "not sure," "slightly agree," and "agree." Section 11 contained three open-ended questions, where the students were asked to describe what they perceived as strengths and/or weaknesses of the RCC, and note any other comments related to the course. These descriptions were included in the qualitative data material.

The interviews and open-ended questions

All the interviews were conducted in the CVCS to comply with COVID-19 restrictions. The interview guide was structured thematically and the follow-up questions under each theme sought to further explore the participants' experiences related to the rapid shift from traditional clinical rotation course to an RCC, their own digital competence, perceived strengths and/or weaknesses of the RCC, experiences with the virtual simulation and the virtual patients, and supervision of students over the 10 weeks in the RCC. Figure 4 gives an overview of the qualitative data.

Ethical considerations

The Norwegian Centre for Research Data (NSD) approved the study (Ref. nr. 674624). All the participants received both written and oral information about

Table 1 Example of the structure of the virtual simulation sessions

Structure of the virtual simulation sessions			
Pedagogical focus	**Pre-assignments**	**Virtual simulation sessions**	**Learning outcomes**
Virtual patient in need of respiratory assessment (A&B) and appropriate nursing interventions	Three virtual patient cases available for as many encounters as the students wanted. One of these cases was marked as the selected case for the group simulation session	75 min group simulation with 8–12 students. Students were divided into active participants and observers throughout the session. • 5–10 min intro and "small talk" • 45–50 min virtual patient encounter and in-depth debriefing • 5–10 min "finishing up" and "how did it go?"	Identify the patient's resources, basic needs, and health condition by using a systematic approach and health assessment. Perform basic physical assessment with focus on respiratory assessment. Verbalize knowledge on characteristics of diseases related to elderly patients

Table 2 Overview of the age range for the nursing students who answered the questionnaire

Age range	Total (%)
20–24	13 (54.2)
25–29	3 (12.5)
30–34	2 (8.3)
35–39	1 (4.2)
40–44	2 (8.3)
45–49	1 (4.2)
50–54	1 (4.2)
Missing	1 (4.2)

the study. The content of the information contained a) aim of the study, b) how to participate, c) the voluntary aspects of the participation, d) the opportunity to withdraw at any time, and e) how the informed consent was collected. The information to the students also included information about returning the online questionnaire was an active form for consent for participation in the study. Due to the COVID-19 restrictions, the students and faculty members participating in the interviews received written information in advance of the interview including; a) information of the video recording, b) information that the video recording would be deleted when the research project had ended, and c) that the recordings from the interviews were stored in secure research domain at the university. The participants gave their consent before the time and date for the interviews were scheduled. All the participants were asked again before starting the video recording and were given the opportunity to reserve themselves from being recorded. However, all the participants consented verbally, as well as actively consenting by "clicking" on pop-up notification allowing the recording to start. Further, the researchers responsible for the study were not involved in any formal evaluation of students' performance in the RCC; hence, students' participation in the study had no impact on their pass/fail outcomes in that course.

Data analysis

Analysis of the questionnaire data

The statistical software package SPSS 26 was used to perform the descriptive and frequency analyses. We calculated mean scores, standard deviation, and range for each item in the section 3 to 10 in the questionnaire.

Analysis of the interviews and open-ended questions

Qualitative inductive content analysis was used to analyze the qualitative data [26]. All the interviews were transcribed verbatim and read thoroughly to obtain an overview of the data. The overall process of analysis involved open coding, grouping codes into subcategories, and then interpreting the subcategories into categories (Table 3). These categories were then abstracted into the main categories.

Convergent mixed-methods analysis

In mixed-methods research, it is important to work towards an integration of the quantitative and qualitative data; as such, after analyzing the different data sets separately, we explored the results collectively to look for any congruence or discrepancy in the data sets, as suggested by Creswell and Plano Clark [24]. This second stage of data analysis revealed new understandings and represented an additional level of synthesis of the overall findings.

Validity, reliability, and analytical rigor

The questionnaire was critically reviewed by the co-authors of this paper. All unclear items were discussed, and a consensus was reached regarding the formulation of each item. Two researchers (HÖE/LGH) read the interviews separately. The open coding, grouping the data into subcategories, and identifying categories were also done separately by HÖE and LGH. Then, the same two researchers completed the abstraction of the data into main categories collaboratively. All researchers finalized the convergent analysis and integrated the data according to the research questions.

Results

In the following section, the results from the quantitative and qualitative analyses are presented separately to emphasize the data provided by the two data collection

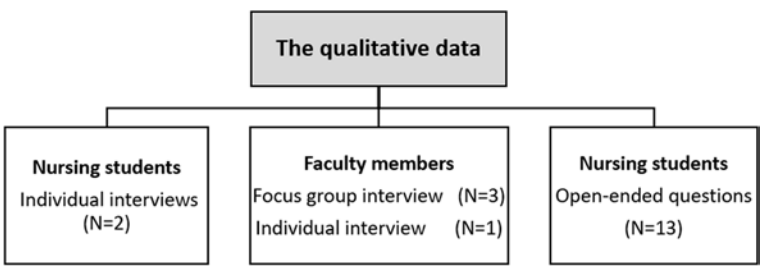

Fig. 4 The extent of the qualitative data

Table 3 Example of the relationship between the questions in the interview guide and the main categories

Questions from the interview guide	Main categories	Faculty member quotes
What are the possibilities and limitations of simulation with virtual patients?	1. The importance of recognizing the students' vulnerability 2. The responsibility of the facilitation in the virtual simulation sessions	*"The students made themselves vulnerable, and threw themselves into the unknown—and they mastered it! I really applaud them for that."* *"I like that the focus is mainly on the process where one stops and dwells on 'What does it mean when the inhalation or the exhalation has a stridor sound?' or 'What exactly is blood pressure and what role does blood pressure have in the circulation system?' or 'What does it mean when blood pressure drops?' You get the opportunity to systematize your knowledge and puzzle it together, which I find very exciting in the immersive simulation."*
What are the strengths or weaknesses in the redesigned clinical course?	3. The value of promoting students' preparedness for future patient encounters	*"We have talked about how to palpate and to inspect—and it is obvious that they* (the students) *will not get the same impression as they would in real-life patient encounters and therefore lack the opportunity to perform the clinical skills 'hands on.' We cannot replace that even if we talk about it."*
Thinking about your own digital literacy: Has it changed after the participation in the redesigned clinical course, and if so, how?	4. The need for more and new pedagogical competence	*"Participating was useful to gain insight about what the students really know when they participate in a simulation like this. I think that you get a good impression of the students' performance through the virtual simulation."*

Table 4 Overview of hours spent per week on available learning activities

Learning activity	N	Mean (SD) hours per week	Range hours per week
Academic assignments	21	14.9 (9.4)	3–45
Reading course literature	18	8.3 (6.1)	0–20
Video lectures and instructional videos	21	4.4 (2.7)	0–10
Simulation with virtual patients	19	3.5 (2.6)	1–10
MOOC	14	1.4 (1.8)	0–6
Podcasts	20	1.3 (1.2)	0–4

Table 5 The importance of the multimedia learning material for understanding how to use B-PAS in future patients encounters

The multimedia learning material	N	Mean (SD)	Range
The video lectures helped me understand how I can use B-PAS in patient encounters	24	4.6 (0.58)	3–5
The instruction videos helped me understand how I can use B-PAS in patient encounters	24	4.6 (0.65)	3–5

methods. Then, in line with convergent design [24], the coherence of the two data sets will be addressed.

The quantitative results

Students' use of the available learning activities

We asked the students to estimate the amount of time spent on the different learning activities during each of the 10 weeks. The data indicate variety in how many hours the students spent on these activities (Table 4). The most time was spent on academic assignments, followed by reading course literature. The students spent an average of 4.4 h per week on the material aimed at supporting the learning of B-PAS, and 3.5 h engaging with the virtual patients. The students spent the least amount of time on the MOOC and the podcasts.

Nursing students' perceived confidence related to learning B-PAS

Most of the students agreed that the multimedia learning material helped them gain a better understanding of the appropriate use of B-PAS in future patient encounters (Table 5).

Overall, the students agreed that participation in the RCC had increased their confidence in performing the different examination techniques and foci related to B-PAS (Table 6). The students perceived themselves as confident in inspecting and auscultating the thorax, inspecting and percussing the abdomen, assessing the motoric system, balance, and

Table 6 Nursing students' perceived confidence in performing B-PAS in future patient encounters

The focus in the multimedia learning material		N	Mean (SD)	Range
The respiratory system	**I am confident that I can…**			
	inspect properly after viewing the multimedia learning material	23	4.3 (1.02)	1–5
	palpate properly after viewing the multimedia learning material	23	4.2 (0.10)	2–5
	percuss properly after viewing the multimedia learning material	24	4.0 (1.25)	1–5
	auscultate properly after viewing the multimedia learning material	24	4.3 (0.86)	2–5
The circulation system and the heart	**I am confident that I can…**			
	inspect properly after viewing the multimedia learning material	24	4.2 (0.93)	2–5
	palpate properly after viewing the multimedia learning material	24	4.1 (0.93)	2–5
	auscultate properly after viewing the multimedia learning material	24	4.0 (1.12)	1–5
The abdominal system	**I am confident that I can…**			
	inspect properly after viewing the multimedia learning material	24	4.3 (0.99)	2–5
	auscultate properly after viewing the multimedia learning material	24	4.2 (0.92)	2–5
	palpate properly after viewing the multimedia learning material	24	4.2 (0.85)	2–5
	percuss properly after viewing the multimedia learning material	24	4.3 (0.71)	3–5
The neurological system	**I am confident that I can…**			
	test the cranial nerves properly after viewing the multimedia learning material	24	4.0 (1.23)	1–5
	test the motoric system properly after viewing the multimedia learning material	24	4.4 (0.82)	2–5
	test balance and coordination properly after viewing the multimedia learning material	24	4.3 (0.82)	2–5
	test peripheral sensibility properly after viewing the multimedia learning material	23	4.3 (0.92)	2–5

Table 7 Nursing students' perceived confidence and mastery of fundamental care in the virtual patient encounters

The simulation with virtual patients helped me…	N	Mean (SD)	Range
become more confident in how to systematically map the patient clinical situation	24	4.5 (0.83)	2–5
understand when to use B-PAS in future patient encounters	24	4.6 (0.71)	2–5
become more confident in how to collect subjective data in patient encounters	24	4.1 (1.35)	1–5
become more confident in how to assess subjective data in patient encounters	24	4.3 (0.10)	1–5
become more confident in how to collect objective data in patient encounters	23	4.6 (0.90)	1–5
become more confident in how to assess objective data in patient encounters	24	4.5 (0.59)	3–5
become more confident in how to assess collected data and to reason possible cause(s) for the patient's clinical situation	23	4.4 (0.94)	1–5
become more confident in clinical decision-making	23	4.2 (1.09)	1–5
experience mastery in the way I verbalize professional knowledge in future patient encounters	24	4.2 (0.93)	2–5
become more confident about my knowledge in anatomy and physiology	24	4.4 (0.71)	3–5
become more confident about my knowledge in pathophysiology and pharmacology	24	4.2 (1.09)	1–5
develop clinical reasoning skills	23	4.5 (0.73)	3–5
develop clinical decision-making skills	24	4.5 (0.78)	2–5

coordination of the patient, and assessing peripheral sensibility. However, the students perceived themselves as least confident in auscultating the heart sounds, percussing the thorax, and testing the cranial nerves.

The learning experiences from the virtual patient encounters

The questionnaire data show that the students experienced the virtual patient encounters as a meaningful learning activity (mean 4.6, SD 0.58, range 3–5) to support the development of confidence in fundamental nursing care (Table 7). Further, the students reported the virtual simulations sessions as a safe learning environment (mean 4.5, SD 0.8, range 2–5), and that it was useful to have the faculty members participate, as well (mean 4.8, SD 0.51, range 3–5). In particular, two items stood out with the highest mean score and one item with the lowest. Despite a wide range of students' scores on some of the items, the majority scored "slightly agree" or "agree" on all items related to the virtual patient encounters.

The questionnaire data indicate that the nursing students had positive experiences with the academic assignments (Table 8). The case assignment stood out as the assignment that the students felt contributed most to their increased confidence in systematically mapping the patients' clinical situation. In contrast, the reflection paper and life story interview were the assignments that received the lowest mean scores.

The majority of the nursing students also reported (Table 9) that the overall content of the RCC gave them increased confidence regarding fundamental care and human bioscience knowledge, which are specific parts of professional knowledge.

The qualitative results

The results from the interviews with the nursing students are presented first, followed by the faculty members' perspectives.

Students' learning in the RCC

Four main categories were identified in the analysis of the interviews with the students, combined with the answers from the open-ended question in the questionnaire: 1)

Table 8 The importance of the academic assignments on students' learning in the RCC

The different academic assignments	N	Mean (SD)	Range
The case assignment helped me feel more confident in systematically mapping the patient clinical situation	24	4.8 (0.42)	4–5
The case assignment helped me feel more confident in knowing the difference between subjective and objective data	24	4.6 (0.89)	1–5
The case assignment helped me feel more confident about my knowledge in fundamental nursing	23	4.6 (0.59)	3–5
The case assignment helped me feel more confident about my knowledge in anatomy and physiology	22	4.4 (0.95)	1–5
The case assignment helped me feel more confident regarding my knowledge in pathophysiology and pharmacology	23	4.3 (1.06)	1–5
The reflection paper helped me become more conscious about own learning processes	21	4.1 (0.96)	3–5
The life story interview helped me become more confident in the communication with older people	22	4.1 (1.06)	1–5
The life story interview helped me become more confident about my knowledge in communication skills	23	4.3 (0.59)	1–5

Table 9 Nursing students' perceived confidence related to fundamental care and human bioscience knowledge

The redesigned clinical course helped me…	N	Mean (SD)	Range
feel more confident about my knowledge in fundamental care	22	4.6 (0.59)	3–5
feel more confident about my knowledge in anatomy and physiology	23	4.1 (1.14)	1–5
feel more confident about my knowledge in pathophysiology and pharmacology	21	4.2 (0.93)	1–5

exploration of professional knowledge fosters development of clinical reasoning skills; 2) caring facilitation contributes to building confidence; 3) using the full potential of the virtual patients is important; and 4) a flexible teaching and learning approach strengthens professional knowledge.

Category 1: Exploration of professional knowledge fosters the development of clinical reasoning skills The students highlighted the virtual simulation sessions as a safe learning environment for sharing their thoughts and reflections with the other participants. In their experience, sharing their reflections and knowledge, and revealing knowledge gaps, made them vulnerable in front of the other students, facilitator, and faculty members. As one of the students explained:

> *The participation is stressful because you are worried about getting it (the answers or actions) wrong. You think that maybe you should avoid saying anything because everybody (the other participants) can think…well they might think something. But you cannot focus on that or let that intimidate you, just carry on and do it.*

However, at the same time, they expressed the importance of having the courage to be vulnerable in this way. One student noted:

> *It's not just a form of communication. This is a way that makes you more aware of your own clinical reasoning because you verbalize it (professional knowledge)…so this becomes a method of learning. I think it's important to talk out loud. You can be in your head, in your brain, but you cannot get it (professional knowledge) out. You know how it (the body) works and you have a lot of knowledge embedded within you, but when it comes to talking about it—that is when it becomes challenging.*

The students felt that the virtual patient encounters were especially helpful for realizing the importance of taking note of clinical cues that appeared during the scenario—and then determining the importance of those cues, and the appropriate actions. One student said: *"In the virtual patient encounters, you can simulate acute situations, for example a stroke, and get your level of knowledge and performance confirmed."* The students also valued the learning activities that were part of the preparation phase, like refreshing professional knowledge within anatomy, pathophysiology, pharmacology, and fundamental nursing interventions. As this student wrote: *"We achieved basic competence in B-PAS and we got the opportunity to link different subjects that we have learned and use it in a specific clinical situation."* Further, the nursing students shared the view that engaging in virtual patient encounters helped them understand how a systematic approach in assessing the clinical situation can aid them in developing clinical reasoning skills.

Category 2: Caring facilitation contributes to building confidence It was important for the students that the facilitator clearly expressed their expectations regarding the students' contribution, participation, and communication. As one student related:

> *The facilitator said, 'Now we are going to work together—you are the ones who suggest what to do and then we are all going to talk together and reflect on the different actions in the case'. Then you just breathe and relax because you think, 'We are going to do this together and we are all in the same boat.*

The students elaborated further on the importance of how the facilitator challenged the students with questions aimed at stimulating verbalization of knowledge via reflections in and on actions. These questions were asked in a kind and non-judgmental way, regardless of whether or not the students knew the answer. One of the students described this as follows:

> *In the virtual patient encounters you could choose actions without doing serious harm to the patient and you can try out different actions—it was never like 'No, this was the wrong answer!' When the facilitator asked, and we (the students) replied, perhaps not with the exact right answer, the facilitator corrected us in a very caring way. It was reassuring to have the facilitator there.*

This also underlines how the students valued being corrected whenever they failed to detect and/or interpret clinical cues and to act accordingly.

Category 3: Using the full potential of the virtual patients is important The students contributed valuable insight into how the virtual patients could be used to integrate theory and practice, and what the role of the faculty should be. From their perspective, a good pedagogical design with a well-structured plan for the virtual patient encounters was essential to optimize the learning experiences and outcomes in the RCC. The students envisioned more frequent use of virtual patients during the first year of the nursing program. After becoming familiarized with this learning activity in the RCC, they would prefer having access to the virtual patients as an additional learning resource in other courses. One student said:

> *I would prefer having it (the virtual patients) more often and for a bit longer than 1 hour and 15 minutes. Perhaps for one and a half hours. That would allow us to talk in more detail about the assessment related to the inspection, palpation, auscultation, and percussion.*

Another student said:

> *The virtual patients should be a regular thing within the different courses. Then you would have a specific case to work on, both on your own and with your study group.*

Furthermore, the students experienced the virtual patient as a learning activity that revives the focus on human bioscience knowledge. Thus, they recommended that the physiological changes or clinical cues in the virtual patient scenarios should be the main focus of the discussions and cognitive reasoning skills grounded in professional knowledge. As this student pointed out:

> *I have had an extra focus on the pathophysiology part. I have read about all the diseases related to every case and it is motivating to try and see how the patient is doing and how you can try to fix the situation.*

The students agreed that it was helpful to have the faculty members responsible for supervision in the RCC also involved in the virtual simulation sessions. One of the students elaborated on this:

> *It is great to meet more frequently and with faculty members. It is great when the faculty members came with inputs. They participate at the same level as you. You do not feel that you are on the same level, but you get more out of it (the virtual patient encounter) when the input or feedback comes from more than one nurse or faculty member—you learn more. I think that the faculty members are there to help and to reflect together with you.*

The involvement of the faculty members was generally experienced by the students as supportive; moreover, by sharing their professional knowledge, they added new perspectives in the virtual patient encounter.

Category 4: A flexible teaching and learning approach strengthens professional knowledge The structure of the RCC gave the students well-appreciated flexibility in terms of time, space, and place for engaging in the learning activities; they felt it was tailored to their everyday life activities and obligations. The following were written in response to the open-ended questions:

> *It was easier to keep up in the lectures, easier to take notes without being interrupted by other students. I could also sit anywhere, like outside and I felt more motivated to engage.*

and *"You can engage in the learning activities whenever it fits with your daily plans."* However, the students were clear that a technology-enhanced clinical course that relies on a high level of interactivity demands self-discipline to "get the job done": *"You have to have the self-discipline to do it* (the learning activities) *because it is important not to think that you will do it later but to actually do it now."* The students found it valuable that the instructional videos and the MOOC involved real people, especially when the students were not meeting real patients in this clinical course. One student said: *"I think that it was cool that it was a real person. That made it a bit more real and more motivating to engage in the course."* Another student said: *"It was so good to see how the examination techniques were done on a real person."* However, the students missed having social interaction, as they were not physically present with their fellow students. This aspect was evident both in the feedback they gave in the interviews and the open-ended questions. As one student asserted: *"The social distance and no physical presence are difficult."* And another explained,

> *One of the strengths of the RCC was that the learning material is accessible all the time and you can revisit whenever it suits you, but I miss the social aspect of being a student.*

Overall, however, the students reported that they felt their level of professional knowledge was strengthened and would benefit future real-life patient encounters.

Faculties' roles and responsibilities as learning facilitators in the RCC

The interviews with the faculty members revealed three main categories: 1) the responsibility for facilitating reflection to stimulate integration between professional knowledge and clinical skills; 2) to promote for students' preparedness for future patient encounters; and 3) the need for new pedagogical and technological competence.

Category 1: The responsibility for facilitating reflection to stimulate integration between professional knowledge and clinical skills The faculty members agreed that the facilitators' main responsibility in the virtual patient encounters was to stimulate reflection on elements of professional knowledge, and how the integration with clinical skills contributed to the development of clinical reasoning skills. They further emphasized how the virtual patient encounters provided the students with unique opportunities to consciously and systematically "explore" the patient's current physiological status, and in that process, also notice clinical cues when sudden changes occurred in the scenario. One of the faculty members said:

> *It is a useful thing to do because it is so concrete. I believe that it gives them (the students) the opportunity to learn a systematic approach and I see in the other cases that you can learn clinical reasoning skills as well.*

Furthermore, the faculty members saw the value of being able to reflect 'in and on actions' and how that revealed the core function of the facilitator role in the virtual patient encounters. As this faculty member explained:

> *I like that the focus is mainly on the process where one stops and dwells on 'What does it mean when the inhalation or the exhalation has a stridor sound?' or 'What exactly is blood pressure and what role does blood pressure have in the circulation system?' or 'What does it mean when the blood pressure drops?' You get the opportunity to systematize your knowledge and puzzle it together, which I find very exciting in the digital simulation.*

The faculty members were also aware that the students were exposed and vulnerable in the simulation sessions. One of the faculty members noted: "*The students made themselves vulnerable and jumped into the unknown—and they mastered it! I really applaud them for that.*" Moreover, faculty members noted their surprise that some of the first-year nursing students already showed an ability to use clinical reasoning skills in virtual patient encounters. Finally, they stressed the benefits of using virtual patients in education, and how the virtual patients can be used to link different aspects of the nursing role, like fundamental care, health assessment, communication skills, and clinical skills.

Category 2: Promoting students' preparedness for future patient encounters Given the circumstances surrounding COVID-19, the faculty members agreed that the RCC was an appropriate substitute allowing the nursing students to fulfill their study progression requirements. In their opinion, the overall organization and scaffolding of the learning activities would benefit the students in future real-life patient encounters. One faculty member said:

> *I primarily think that the students have learned how to work systematically by using the tool (the virtual simulation), which represents in a way a clinical context. I think that they (the students) will benefit greatly from this (the virtual patient) when they meet patients later on. I think this is a major strength of this specific learning activity.*

The faculty members also highlighted the shortcomings of being unable to participate in real-life clinical contexts, including normal verbal and non-verbal communication with patients and listening to their personal stories. Here, they felt the students also lacked the dimension of learning from environmental impressions, such as different smells, sounds, and being able to touch the patients physically. One faculty member said:

> *We have talked about how to palpate and to inspect—and it is obvious that they (the students) will not get the same impression as they would in real-life patient encounters and therefore lack the opportunity to perform the clinical skills 'hands-on.' We cannot replace that even if we talk about it.*

In other words, the faculty members felt that, though the RCC provided the students with meaningful learning activities, this type of clinical course could never replace real-life learning experiences in a clinical context.

Category 3: The need for new pedagogical and technological competence The faculty members elaborated on the importance of having the pedagogical and digital competence required to redesign a clinical course strategically. They acknowledged the complexity of scaffolding different learning activities, planning for student supervision, supporting the use of different digital learning resources, and creating a safe learning environment that promotes discussion, reflection, and learning. They experienced it as challenging to support and motivate student

engagement, to promote useful and meaningful communication, and to decide which methods are best-suited to assessing students' performance and level of knowledge in an RCC. One faculty member said: *"I discovered and learned that you had to be pretty lively and entertaining to avoid having the communication, supervision or teaching become monotone."* The faculty members valued participation in the virtual patient encounters because they experienced it as essential to get the right "feeling" and understanding of how knowledgeable the students were in the virtual patient encounters. One faculty member stated that:

> *Participating was useful to gain insight into what the students really know when they participate in a simulation like this. I think that you get a good impression of the students' performance through the virtual simulation.*

Further, the faculty members experienced it as important for their role to help the students work towards reaching the learning outcomes in the RCC and that the available learning activities in the RCC were an invaluable resource. A few of the faculty members were surprised by how inexperienced some students appeared to be, regarding seeing each other on-screen. One of them said:

> *There are people in the group who have seen each other just in a sports top in the skill lab! It is a bit strange to notice what happens when we all of a sudden are seeing each other on a screen. Suddenly we cannot show ourselves and the screens turn black.*

The faculty members agreed that these "black screens" made them feel insecure, and emphasized that it is challenging to supervise students through black screens—hearing only a voice without a face.

The integration of the mixed-methods results

The results from the two data sets were coherent and complementary in many ways (Table 10). Concerning the integration of the data, Creswell & Plano Clark [24] argue that coherence between quantitative and qualitative results can increase the credibility of the overall findings from a mixed-methods study. The quantitative data highlight how the students perceive their confidence related to understanding when it is appropriate to use B-PAS in future patient encounters, and how the virtual patient scenarios helped students learn structured patient assessment. Complementary findings emerged in the qualitative findings. The students and faculty members had similar experiences and perspectives regarding learning in the virtual patient encounters and about the RCC. It is worth highlighting that students' clinical reasoning skills and learning of structured patient assessment were emphasized in both groups. In addition, both students and faculty members asserted that the RCC was a necessary substitutional "clinical" course during

Table 10 The coherence and discrepancy in the data sets

Quantitative results	Qualitative results	
Students' perspectives	**Students' perspectives**	**Faculty members' perspectives**
Use of the available learning activities	**3)**[a] Using the full potential of the virtual patients is important **4)** A flexible teaching and learning approach strengthens professional knowledge	**3)**[b] The need for new pedagogical and technological competence
Perceived confidence in using B-PAS in future patient encounters	**2)** Caring facilitation contributes to building confidence **3)** Using the full potential of the virtual patients is important	**1)** The responsibility for facilitating reflection to stimulate integration between professional knowledge and clinical skills
Learning experiences from the virtual patient encounters	**1)** Exploration of professional knowledge fosters the development of clinical reasoning skills **2)** Caring facilitation contributes to building confidence **3)** Using the full potential of the virtual patients is important **4)** A flexible teaching and learning approach strengthens professional knowledge	**1)** The responsibility for facilitating reflection to stimulate integration between professional knowledge and clinical skills **2)** Promoting students' preparedness for future patient encounters
Importance of the academic assignments in the RCC for students' learning	**1)** Exploration of professional knowledge fosters the development of clinical reasoning skills	**3)** The need for new pedagogical and technological competence **3)** The need for new pedagogical and technological competence

[a] The numbers indicate the main categories in the qualitative results regarding the students' perspectives

[b] The numbers indicate the main categories in the qualitative results regarding the faculty members' perspectives

the pandemic. However, it was discussed that the art of nursing also needs to be learned in authentic hands-on patient encounters in real-life clinical practice. The only discrepancy between the data sets was that faculty members shared their reflections regarding their role and competence as educators and facilitators in a RCC.

Discussion

This study contributes to the literature with three main findings: 1) a technology-enhanced learning environment can enhance students' preparedness for future clinical practice; 2) facilitation in virtual patient encounters can uncover the "red thread" within nursing education, thereby fostering early development of clinical reasoning skills; and 3) new technology-enhanced learning activities call for new pedagogical competence among faculty members.

A technology-enhanced learning environment can enhance students' preparedness for future clinical practice

The nursing students experienced that the different learning activities in the RCC contributed to learning fundamental care in nursing, despite being conducted in a technology-enhanced learning environment. The students highlighted the case assignment, the multimedia learning material, and the virtual patients being especially helpful. It was noted that although "hands-on" B-PAS training was not possible, another important dimension of learning B-PAS was achieved: the students acquired an understanding of *when* and *why* B-PAS should be used when performing health assessment in real-life patient encounters. They therefore felt prepared for and confident in using B-PAS to perform health assessment, as a part of fundamental care in nursing. This concurs with other research highlighting the benefits of multimedia learning material and virtual patients for learning health assessment, thereby increasing students' preparedness for direct patient care [16, 17, 23, 27]. Despite the limitation of learning fundamental care and clinical skills in a technology-enhanced environment, the value of the study results can inspire the development of hybrid solutions for future clinical course designs in nursing education.

One of the study findings draws attention to the benefits and feasibility of the varying the different learning activities in a technology-enhanced learning environment. The combination of "traditional" academic assignments and technology-enhanced learning activities can be considered a strength of the RCC, according to the students and the faculty members. This concurs with other research highlighting that technology-enhanced learning material can be utilized in many ways in nursing education, to support learning fundamental care, health assessment, clinical skills, and preparedness for clinical practice [7, 14, 15, 20, 23]. Nevertheless, as Àlvarez-Nieto et al. [27] argue, it is important to invite both students and faculty members to critically evaluate the multimedia learning material created for educational purposes. This entails that students and faculty assess the relevance, design, format, and content quality of the learning material. The content of the suite of mLearning tools used in this study was co-designed with nursing students, also aiming to evaluate format, design, and quality [5]. The current study supports the relevance and usefulness of this Suite of mLearning tools: the students valued the virtual patient encounters, but also the MOOC with video-recorded examples of health assessment in encounters with patients. The faculty also valued the usefulness of the pedagogical approach in the RCC.

Facilitation in virtual patient encounters should uncover the "red thread" within nursing education, fostering early development of clinical reasoning skills

The common link, here understood as the "red thread"—between professional knowledge, clinical skills, and clinical reasoning skills—is not always apparent for novice students. In this study, students and faculty members shared the opinion that the collaboration between the experienced facilitator, faculty members, and the students stimulated in-depth reflections and higher cognitive thinking, which made this "red thread" more evident. Six main characteristics were extracted from the qualitative data, highlighting central aspects of the facilitator role in the virtual patient encounters essential for student learning. The first five are: 1) explaining the rules of engagement; 2) clarifying different roles in the virtual simulation; 3) acknowledging students' vulnerability; 4) communicating with care when correcting students' incorrect answers; and 5) adjusting and modeling clinical reasoning skills. These aspects are supported by Deschênes et al. [20], who argue that pedagogical feedback and more Socratic ways of exploring one's thinking and knowledge are closely related to the early phases of developing clinical reasoning skills. In addition, Gordon [28] emphasizes that debriefing (understood here as providing feedback) in the virtual simulation should aim to stimulate critical thinking and the connecting of the virtual patients' clinical situations with real-world situations. The stop and pause action in the virtual simulation software offered this kind of exploration and linking of the virtual situation to real patient situations. This in turn linked different areas of professional knowledge, clinical skills, and clinical reasoning, which were then more consciously integrated into the students' language, cognitive

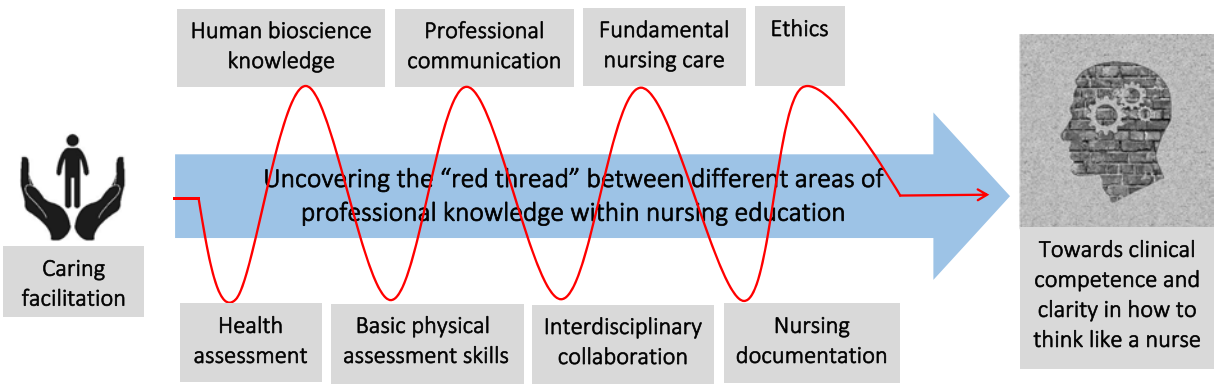

Fig. 5 Uncovering the "red thread" within nursing education

thinking, and learning processes. This brings forward the sixth central aspect of the facilitator role: 6) careful navigation of the in-depth exploration that uncovers the "red thread" between fundamental care and different areas of professional knowledge in nursing (Fig. 5). This explorative nature of the engagement with the virtual patients appealed to both students and faculty members in this study.

In this way, the students' confidence can be appropriately stimulated in what was viewed by the students as a vulnerable learning situation. Deschênes et al. [20] support this pedagogical strategy and emphasize that when students put their thoughts and cognitive reasoning into words, it helps them integrate different areas of knowledge and develop clinical reasoning skills.

It was clear in both data sets that the students found that the involvement of faculty members in the simulation sessions added value to the total learning experience. This is also in line with Deschênes et al.'s [20] review showing that modeling clinical reasoning skills is highly beneficial for students learning these cognitive processes. The nursing students in current study also expressed that they would prefer to spend more time with the virtual patient and re-visit the clinical situation. This may boost their learning from earlier virtual patient encounters [16, 17].

New technology-enhanced learning activities call for new pedagogical competence among faculty members

The COVID-19 lockdown and its consequences for the education sector were challenging for both nursing students and faculty members. In the qualitative interviews, the faculty members expressed the need to increase their confidence and competence regarding working in and using a technology-enhanced learning environment, such as the RCC. As Koehler and Mishra [4] underline, understanding the affordances of the chosen technology and its potential pedagogical advantages represent an important competency that faculty members need to acquire [4]. This also becomes visible when new technology-enhanced learning resources and educational innovations (e.g., virtual patients) are rapidly implemented without a firm grounding in pedagogical thinking on how best to utilize these to benefit teaching and learning [22]. The faculty members supervising the students in the current study did not have the opportunity to explore the technology-enhanced learning activities in advance of the RCC, due to the suddenness of the COVID-19 lockdown. As such, they lacked knowledge on how to utilize the pedagogical potential of these activities (e.g., the virtual patient encounters) to the fullest.

The faculty members also expressed a desire to develop this competence further, highlighting a need for the development of "train-the-trainer" course in this area. This draws attention to the complexity of the competencies needed to take advantage of the interaction between technology and pedagogy—as highlighted in the TPACK framework.

Limitations and strengths

An important limitation of this study is that most of the first-year students lacked prior experience from clinical practice with which they could compare their perceived learning experiences from the RCC. However, the students attended learning activities in the skill lab on campus prior to the pandemic, where they worked with fellow students, training in fundamental care activities like B-PAS, and many other related clinical skills. Further, the students and faculty members provided valuable insight into learning experiences in the RCC and related to the different learning activities; these also highlight initial lessons learned to clarify pedagogical strategies that may be beneficial in disruptive times, with implications for post-pandemic educational practices.

In addition, the study's explorative convergent mixed-methods design strengthened the exploration of a new educational design. Since this was the first time a clinical course was redesigned into a technology-enhanced learning environment, the study had an explorative nature and the sample size was small. However, the participants had large information power, which justifies lower sample sizes [29]. This is important to highlight, as future research should investigate the effect of the different learning activities used in the RCC on student learning in a larger educational context. It would also be beneficial for future research to focus on comparing results from studies with students that were not impacted by the COVID-19 pandemic and the results from this study. Furthermore, the questionnaire used was designed to target the aims of this study and should be comprehensively validated in studies to come. A further limitation of the study is the lack of representation of both genders in the participant groups, as only one man was among the study participants.

Conclusion

This study shows that in an RCC, a combination of traditional academic assignments, a Suite of mLearning tools, and virtual patients can help nursing students learn fundamental nursing care and be prepared for future clinical hours. The virtual patients played a significant role in providing learning situations that promote systematic health assessment to stimulate early development of clinical reasoning skills. Learning and engaging with virtual patients in a safe, virtual space appeared to have fostered students' confidence, and supported their growth into their future professional role as a nurse. Further, the facilitator's acknowledgment of students' vulnerability and their caring facilitation in the virtual simulation played an important role in role modeling, and exploring coherence in professional knowledge, clinical skills and clinical reasoning skills. This study also highlights the gap in pedagogical competence among faculty members regarding facilitating learning in a technology-enhanced learning environment. The implications of this study should be considered in the context of post-pandemic times, when problems with sufficient access to "real-life clinical rotation activities" are mitigated. Nevertheless, there is a need to develop technological solutions and hybrid pedagogical designs that enhance students' preparedness for patient encounters, which in turn will ensure patients integrity and safety.

Abbreviations

mLearning: Mobile learning; TPACK: Technological, Pedagogical, and Content Knowledge framework; RCC: Redesigned clinical course; FoC: Fundamentals of Care framework; B-PAS: Basic physical assessment skills; CVCS: Commercial video conferencing system; ABCDE: Airways, Breathing, Circulation, Disability, and Exposure; MOOC: Massive open online course; LMS: Learning management system.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12912-022-00872-8.

Additional file 1. God Reporting of A Mixed Methods Study (GRAMMS) guideline.

Acknowledgments

Not applicable.

Authors' contributions

HÖE: conception, study design, recruitment of participants, data collection, data analysis and interpretation, drafting, editing, and critical revision of the manuscript. LGH: study design, data analysis and interpretation, editing, and critical revision of the manuscript. EAB, KRB, and AM: study design, editing, and critical revision of the manuscript. HE: conception, study design, data analysis and interpretation, drafting, editing, and critical revision of the manuscript. All the authors have read and approved the final version of the manuscript, and have agreed to be accountable for all aspects of the work.

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Availability of data and materials

The metadata from the qualitative and quantitative datasets that are used and analysed during the current study are available from the corresponding author on request.

Declarations

Ethics approval and consent to participate

The Norwegian Centre for Research Data (NSD) approved every aspect of the study, including the consent procedure (Project No. 674624). According to the definitions in national regulations [30] and a local protocol at the university [31], further approval from a medical ethical committee was not necessary since the study centred around students´learning. The Faculty of Health and Social Sciences at the actual university also approved the study. All participants were informed about confidentiality, voluntary nature of participation, the possibility to withdraw from the study at any time, information on how the research data would be saved and deleted at the end of the research period. Informed consent was obtained. Due to COVID-19 restrictions, NSD was consulted regarding the ethical aspects of conducting the interviews online using CVCS and video recording of the interviews. Additional information was given to the participants in the interviews to inform the aim of the video recording, the possibility to reserve oneself from being recorded, and that the data would be stored in a secure server at the university. This was important to specify and clarify before the interviews were conducted.
All the methods in the study were performed in accordance with relevant guidelines and the Good Report of A Mixed Method Study (GRAMMS) guideline was used (see supplementary file).

Consent for publication

No applicable.

Competing interests

The authors declare that there are no conflicting interests.

Author details

[1]Centre for Health and Technology, Faculty of Health and Social Sciences, University of South-Eastern Norway, Grønland 58, 3045 Drammen, Norway. [2]Institute of Health and Society, Faculty of Medicine, University of Oslo, Forskningsveien 2B, 0371 Oslo, Norway.

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Publisher's Note

Appendix 1

Detailed description of the pedagogical plan at the university, based on scaffolding and spaced repetition aiming to build students' competence and confidence in performing B-PAS. It is important to note that despite B-PAS being categorized as both skills knowledge and, in the table, both elements are included when the term 'B-PAS' is used in this dissertation.

1st educational year		
Autumn semester		
Learning outcomes	**Learning activities**	**Location**
KNOWLEDGE To learn professional knowledge concerning normal bodily functions and the fundamental difference between the subjective and objective data	Theoretical lectures on fundamental nursing care focus on nursing care patients with problems related to respiration, circulation, and elimination	Traditional lecture in a large auditorium on campus.
SKILLS To learn how to perform the examination techniques (inspection, palpation, percussion, auscultation) To learn the systematic approach concerning: **(a)** respiratory assessment, **(b)** peripheral circulation and heart assessment, and **(c)** abdominal assessment	Mandatory written assignment for the anatomy and physiology course	Three hours in the skill lab, performing a B-PAS with a peer supervised by a faculty member
Spring semester		
Learning outcomes	**Learning activities**	**Location**
KNOWLEDGE To learn professional knowledge concerning normal body functions To learn the fundamental difference between the subjective and objective data collection	Repeated training to reinforce the performance of B-PAS as a part of the preparation work before the first clinical rotation course in nursing homes	Three hours in the skill lab, performing a B-PAS with a peer supervised by a faculty member

SKILLS To learn the systematic approach concerning: **(d)** Neurological assessment, Additional focus on repetition and reinforcement of the first three B-PAS foci		
2nd educational year		
Autumn semester		
Learning outcomes	**Learning activities**	**Location**
KNOWLEDGE To integrate and articulate professional knowledge, especially related to pathophysiology, pharmacology, and fundamental nursing care in the context of B-PAS **SKILLS** Repeated training and practising of the examination techniques and the systematic approach in all four B-PAS assessments	Mandatory student participation to reinforce the performance of B-PAS as part of the preparation work before clinical rotation course in a medical or surgical ward	Three hours in the skill lab **First part:** repeated training and reinforcement of the performance of B-PAS **Second part:** simulation (role play) focusing on performing relevant B-PAS on 'a patient' played by peer. A faculty member supervises the simulation activity and give feedback, together with peers, after the simulation
Spring semester		
Learning outcomes	**Learning activities**	**Location**
KNOWLEDGE To integrate and articulate professional knowledge, especially related to pathophysiology, pharmacology, and fundamental nursing care in the context of B-PAS **SKILLS** Repeated training and practising the examination techniques and the systematic approach in all four B-PAS assessments	Mandatory student participation to reinforce the performance of B-PAS as part of the preparation work before the clinical rotation course in medical or surgical wards	Three hours in the skill lab **First part:** repeated training and reinforcement of the performance of B-PAS **Second part:** simulation (role play) focuses on performing a relevant B-PAS on 'a patient' played by a peer. A faculty member supervises the simulation activity and give feedback, together with peers, after the simulation
3rd educational year		

Autumn semester		
Learning outcomes	**Learning activities**	**Location**
KNOWLEDGE Focusing on the integration of human bioscience topics and fundamental nursing care to highlight clinical reasoning and decision making skills. Additional foci are using structured communication (e.g., ISBAR[8]) and ABCDE **SKILLS** Repeated training and practising the examination and the systematic approach in all four B-PAS assessments	Mandatory student participation to reinforce the performance of B-PAS as a part of the preparation work before the clinical rotation in home-care based nursing care	One day in the skill lab **First part:** practical training in performing B-PAS **Second part:** simulation (role play) focusing on performing relevant B-PAS related to the patient's situation (patient played by a peer). Peers and faculty member observe the simulation and give feedback together **Third part:** two of the cases are analysed in plenary to highlight clinical reasoning processes and clinical decision-making
Spring semester		
Learning outcomes	**Learning activities**	**Location**
KNOWLEDGE Focusing on the integration of human bioscience topics and fundamental nursing care to highlight clinical reasoning and decision making skills. Additional foci are structured communication (e.g., ISBAR) and ABCDE **SKILLS** Repeated training and practising the examination techniques and the systematic approach in all four B-PAS assessments	Mandatory student participation to reinforce the performance of B-PAS as a part of the preparation work before the clinical rotation in home-care based nursing care	One day in the skill lab **First part:** practical training in performing B-PAS **Second part:** simulation (role play) focusing on performing relevant B-PAS related to the patient's situation (patient played by a peer). Peers and faculty member observe the simulation and give feedback together **Third part:** two of the cases are analysed in plenary to highlight the clinical reasoning processes and clinical decision-making

[8] ISBAR: Identification, Situation, Background And Recommendations.

Appendix 2

The wording of the 13 confidence items in study III and the 15 confidence items in study IV in Norwegian language.

13 CONFIDENCE ITEMS IN STUDY III								
Hvor enig er du i følgende påstander:								
1	Jeg er sikker på at jeg kan inspisere riktig i undersøkelse av **perifer sirkulasjon**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
2	Jeg er sikker på at jeg kan utføre palpasjon riktig i undersøkelse av **perifer sirkulasjon**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
3	Jeg er sikker på at jeg kan utføre auskultasjon riktig i undersøkelse av **hjertet**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
Hvor enig er du i følgende påstander:								
4	Jeg er sikker på at jeg kan inspisere riktig i undersøkelse av **lunger**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
5	Jeg er sikker på at jeg kan utføre palpasjon riktig i undersøkelse av **lunger**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
6	Jeg er sikker på at jeg kan utføre perkusjon riktig i undersøkelse av **lunger**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
7	Jeg er sikker på at jeg kan utføre auskultasjon riktig i undersøkelse av **lunger**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
Hvor enig er du i følgende påstander:								
8	Jeg er sikker på at jeg kan inspisere riktig i undersøkelse av **mage og tarm**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
9	Jeg er sikker på at jeg kan utføre auskultasjon riktig i undersøkelse av **mage og tarm**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig
10	Jeg er sikker på at jeg kan utføre palpasjon riktig i undersøkelse av **mage og tarm**	svært uenig	uenig	Litt uenig	vet ikke	Litt enig	enig	svært enig

11	Jeg er sikker på at jeg kan utføre perkusjon riktig i undersøkelse av **mage, tarm og urinveier**	svært uenig ___	uenig ___	Litt uenig ___	vet ikke ___	Litt enig ___	enig ___	svært enig ___
Hvor enig er du i følgende påstander:								
12	Jeg er sikker på at jeg kan inspisere riktig i undersøkelse av **nervesystemet**	svært uenig ___	uenig ___	Litt uenig ___	vet ikke ___	Litt enig ___	enig ___	svært enig ___
13	Jeg er sikker på at jeg kan utføre palpasjon riktig i undersøkelse av **nervesystemet**	svært uenig ___	uenig ___	Litt uenig ___	vet ikke ___	Litt enig ___	enig ___	svært enig ___

15 CONFIDENCE ITEMS IN STUDY IV							
Hvor enig er du i følgende påstander:							
1	Jeg er tryggere på at jeg kan inspisere riktig i undersøkelse av lunger etter å ha sett på videoforelesningen og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __
2	Jeg er tryggere på at jeg kan utføre palpasjon riktig i undersøkelse av lunger etter å ha sett på videoforelesningen og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __
3	Jeg er tryggere på at jeg kan utføre perkusjon riktig i undersøkelse av lunger etter å ha sett på videoforelesningen og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __
4	Jeg er tryggere på at jeg kan utføre auskultasjon riktig i undersøkelse av lunger etter å ha sett på videoforelesningen og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __
Hvor enig er du i følgende påstander:							
5	Jeg er tryggere på at jeg kan inspisere riktig i undersøkelse av perifer sirkulasjon etter å ha sett på videoforelesning og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __
6	Jeg er tryggere på at jeg kan utføre palpasjon riktig i undersøkelse av perifer sirkulasjon etter å ha sett på videoforelesning og instruksjonsvideo	Litt uenig __	vet uenig __	Litt ikke __	enig __	enig __
7	Jeg er tryggere på at jeg kan utføre auskultasjon riktig i undersøkelse av hjertet etter å ha sett på videoforelesning og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __
Hvor enig er du i følgende påstander:							
8	Jeg er tryggere på at jeg kan inspisere riktig i undersøkelse av mage og tarm etter å ha sett på videoforelesning og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __
9	Jeg er tryggere på at jeg kan utføre auskultasjon riktig i undersøkelse av mage og tarm etter å ha sett opp videoforelesning og instruksjonsvideo	uenig __	Litt uenig __	vet ikke __	Litt enig __	enig __

10	Jeg er tryggere på at jeg kan utføre palpasjon riktig i undersøkelse av mage og tarm etter å ha sett på videoforelesning og instruksjonsvideo	uenig	Litt uenig	vet ikke	Litt enig	enig
11	Jeg er tryggere på at jeg kan utføre perkusjon riktig i undersøkelse av mage, tarm og urinveier etter å ha sett på videoforelesning og instruksjonsvideo	uenig	Litt uenig	vet ikke	Litt enig	enig
Hvor enig er du i følgende påstander:						
12	Jeg er tryggere på at jeg kan teste hjernenervene i undersøkelse av nervesystemet etter å ha sett på videoforelesning og instruksjonsvideo	uenig	Litt uenig	vet ikke	Litt enig	enig
13	Jeg er tryggere på at jeg kan teste motorikken riktig i undersøkelse av nervesystemet etter å ha sett på videoforelesning og instruksjonsvideo	uenig	Litt uenig	vet ikke	Litt enig	enig
14	Jeg er tryggere på at jeg kan teste balanse og koordinasjon riktig i undersøkelse av nervesystemet etter å ha sett på videoforelesning og instruksjonsvideo	Litt uenig	vet uenig	Litt ikke	enig	enig
15	Jeg er tryggere på at jeg kan teste sensibiliteten riktig i undersøkelse av nervesystemet etter å ha sett på videoforelesning og instruksjonsvideo	uenig	Litt uenig	vet ikke	Litt enig	enig

Appendix 3

Kirsten Røland Byermoen
Institutt for sykepleie- og helsevitenskap Høgskolen i Sørøst-Norge

3603 KONGSBERG

Vår dato: 27.04.2017 Vår ref: 53525 / 3 / HIT Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 09.03.2017. Meldingen gjelder prosjektet:

53525	*Evalueringsstudie knyttet til grunnleggende systematisk klinisk undersøkelse og vurdering (G-SKUV) på bachelorutdanningen i sykepleie ved Høgskolen i Sørøst Norge, campus Drammen*
Behandlingsansvarlig	*Høgskolen i Sørøst-Norge, ved institusjonens øverste leder*
Daglig ansvarlig	*Kirsten Røland Byermoen*

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

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

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

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 01.08.2017, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Kjersti Haugstvedt

Hildur Thorarensen

Kontaktperson: Hildur Thorarensen tlf: 55 58 26 54

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 53525

Utvalget informeres skriftlig og muntlig om prosjektet og samtykker til deltakelse. Informasjonsskriv mottatt 26.4.2017 er godt utformet.

Personvernombudet legger til grunn at forsker etterfølger Høgskolen i Sørøst-Norge sine interne rutiner for datasikkerhet.

Questback er databehandler for prosjektet. Høgskolen i Sørøst-Norge skal inngå skriftlig avtale med Questback om hvordan personopplysninger skal behandles, jf. personopplysningsloven § 15. For råd om hva databehandleravtalen bør inneholde, se Datatilsynets veileder: http://www.datatilsynet.no/Sikkerhet-internkontroll/Databehandleravtale/.

Forventet prosjektslutt er 01.08.2017. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:
- slette direkte personopplysninger (som navn/koblingsnøkkel)
- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)
- slette digitale lydopptak

Vi gjør oppmerksom på at også databehandler (Questback) må slette personopplysninger tilknyttet prosjektet i sine systemer. Dette inkluderer eventuelle logger og koblinger mellom IP-/epostadresser og besvarelser.

Sikt

Vurdering av behandling av personopplysninger

Referansenummer
462735

Vurderingstype
Standard

Dato
26.03.2021

Prosjekttittel
Collaborative development of digital learning resources promoting clinical reasoning in nursing education involving undergraduate nursing students and faculty member

Behandlingsansvarlig institusjon
Universitetet i Sørøst-Norge / Fakultet for helse- og sosialvitenskap / Institutt for helse-, sosial- og velferdsfag

Prosjektansvarlig
Hilde Eide

Prosjektperiode
14.01.2019 - 31.12.2022

Kategorier personopplysninger
Alminnelige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 31.12.2025.

Meldeskjema

Kommentar
NSD har vurdert endringen. Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 26.03.2021. Behandlingen kan fortsette.

Endring: Papirbasert spørreskjemaet er fjernet som datakilde, og Conexus er fjernet som databehandler.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Sikt

Vurdering av behandling av personopplysninger

Referansenummer
674624

Vurderingstype
Standard

Dato
26.08.2020

Prosjekttittel
Grunnleggende Systematisk Klinisk Undersøkelse og vurderingsferdigheter (G-SKUV) og digital undervisningspraksis

Behandlingsansvarlig institusjon
Universitetet i Sørøst-Norge / Fakultet for helse- og sosialvitenskap / Institutt for sykepleie- og helsevitenskap

Prosjektansvarlig
Hilde Eide

Prosjektperiode
19.08.2019 - 31.12.2022

Kategorier personopplysninger
Alminnelige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 31.12.2027.

Meldeskjema

Kommentar
NSD har vurdert endringen registrert 25.08.20.

Nettskjema er lagt til som databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 26.08.20. Behandlingen kan fortsette.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet/pågår i tråd med den behandlingen som er dokumentert.

Lykke til videre med prosjektet!

Kontaktperson hos NSD: Silje F. Opsvik
Tlf. Personverntjenester: 55 58 21 17

Til Lise Gladhus
Instituttleder for sykepleie og helsevitenskap

Forespørsel om tillatelse til å gjennomføre utvikling og utprøving av digitale læringsressurser knyttet til G-SKUV ved bachelorutdanningen campus Drammen.

1.1 2019 startet jeg i treårig stipendiat stilling knyttet til ReCCiNE prosjektet. Prosjektet beskrives i sin helhet i prosjektplanen som dannet grunnlaget for opptak til PhD programmet «Person-centered Healthcare» (vedlagt). Hovedveilederen min er professor Hilde Eide og biveiledere er professor Anne Moen og førsteamanuensis Lena Heyn. Espen Brembo er også med i prosjektgruppen uten å ha veiledningsansvar.

I en evalueringsstudie (gjennomført 2017-2018) ble alle studenter ved bachelorutdanningen campus Drammen spurt hva de brukte av G-SKUV undersøkelsene og hva skulle til for at de fikk det til å arbeide mer med G-SKUV i praksis. Et av studentenes svar til dette var at tilgang til digitalt læringsverktøy ville støtte opp under og bidra til økt bruk av G-SKUV i praksis. Dette resultatet er hovedgrunnlaget for tematikken i PhD prosjektet.

Jeg søker herved om tillatelse til 1) våren 2019 å invitere sykepleiestudenter fra alle studieår til samskaping av digital læringsressurs knyttet til bruken av G-SKUV og 2) utprøving av denne ressursen for alle tre kull i en klinisk praksisperiode høsten 2019 og våren 2020 med tilhørende spørreundersøkelse for egenvurdering før og etter praksisperioden.

Praksisstudiene er en krevende og hektisk periode for studentene med mange skriftlige innleveringer som brukes blant annet til å evaluere studentenes kunnskap og progresjon. Samtidig er det viktig at studentene har mulighet til og velger å engasjere seg i forskning, kanskje spesielt utdanningsforskning som speiles i ReCCiNE prosjektene. Jeg lurer derfor om der er mulighet til å redusere skriftlige innleveringer i den ene praksisperioden som læringsverktøyet testes ut. Det siktes ikke til å redusere arbeidskravet i praksisperiodene som har sterk tilknytting til bestått/ikke bestått evaluering, men heller de andre oppgavene som for eksempel refleksjonsnotatet hos andre års studentene. Hvilke oppgaver som kan reduseres vil være naturlig og viktig å drøfte med programansvarlig og emneledere i praksisstudiene.

I det redegjør jeg kort litt mer om de tre del-studiene som er planlagt i PhD prosjektet.

Studie 1 har som formål å utforme og designe digitale læringsressurser sammen med gruppe studenter fra alle tre kull. Det vektlegges prosesser som fremmer samskaping og kunnskapsutvikling i fellesskap. Gjennom tre workshop med hver studentgruppe løftes frem G-SKUV som tematikk og det diskuteres studentenes læringsbehov i praksis, ulike innholdskomponenter til verktøyet og progresjon fra første til tredje år. Datasamlingen er allerede i gang og studentene er engasjerte. Utformingen og designet av verktøyet innebærer å lage instruksjonsvideoer, podcast, oppgaver, digital simuleringsprogram, multiple choice spørsmål med mer. Arbeidet med å produsere materialet (instruksjonsvideoer) er allerede i gang. Målet er at digitale læringsressursen skal være klar i midten av august 2019.

Et viktig element knyttet til denne studien er at innholdet i digitale læringsressursen kan anvendes i undervisning, i preklinikken og i andre veiledningskurs for eksempel for praksisveiledere.

Studie 2 har til hensikt å teste ut de digitale læringsressursene i en klinisk praksisperiode i alle kull høsten 2019 og vår 2020. Dette for å finne ut om tilgang til og bruk av digitale ressurser bidrar til økt bruk av G-SKUV og om det har effekt på klinisk vurderingskompetanse. Det er planlagt pre- og posttest som innebærer at studentene svarer på spørreskjemaer helt i oppstarten og i slutten av samme praksisperiode.

Planen for utprøving og datasamlingen er som følger:
- første års studentene i første praksisperiode, sent våren 2020.
- andre års studentene i medisinsk eller kirurgisk praksisperiode sent høst 2019 eller tidlig vår 2020
- tredje års studentene i praksis i hjemmetjenesten høsten 2019 eller tidlig vår 2020
(Se visuell fremstilling av tidspunkt for datasamling etter presentasjon av delstudie 3)

Studie 3 har som mål er å undersøke hvordan studentene selv evaluerer egen kompetanseutvikling spesielt knyttet til arbeid med G-SKUV og kliniske vurderingsferdigheter. Derfor vil alle sykepleiestudentene bli spurt om å svare på spørreskjema på slutten av hvert utdanningsår (før arbeid med bacheloroppgaven starter hos tredje års studentene) for å finne ut av dette.

Rød farge indikerer datasamling knyttet til studie 2 og lilla farge indikerer når datasamling knyttet til studie 3 vil forgå.

	Høst 2019					Vår 2020					
	Aug	Sep	Okt	Nov	Des	Jan	Feb	Mar	Apr	Mai	Jun
1. års studenter											
Refined Giddens questionnaire									X1		X1
Communication questionnaire									X1		X1
ProffNurse SAS											X
2. års studenter											
Refined Giddens questionnaire			X1		X1	X1		X1			
Communication questionnaire			X1		X1	X1		X1			
ProffNurse SAS											X
3. års studenter											
Refined Giddens questionnaire	X1		X2 IX1		X2	X1		X1			
Communication questionnaire	X1		X2 IX1		X2	X1		X2			
ProffNurse SAS								X			

Med vennlig hilsen
H. Ösp Egilsdottir, PhD stipendiat

Fra: Lise Gladhus <Lise.Gladhus@usn.no>
Sendt: torsdag 16. mai 2019 07:26
Til: Hugrun Ösp Egilsdottir <Osp.Egilsdottir@usn.no>
Kopi: Hilde Eide <Hilde.Eide@usn.no>
Emne: RE: Søknad om tillatelse for forskning

Hei
Takk for søknad.
Dette er i orden.
Lykke til!

Med vennlig hilsen

Lise Gladhus

Instituttleder
Fakultet for helse- og sosialvitenskap
Institutt for sykepleie- og helsevitenskap, campus Porsgrunn - Vestfold - Drammen

Tel: +47 31 00 87 74 **Mob:** +47 906 29 828
lise.gladhus@usn.no
www.usn.no

Universitetet i Sørøst-Norge

From: Hugrun Ösp Egilsdottir <Osp.Egilsdottir@usn.no>
Sent: søndag 5. mai 2019 18:31
To: Lise Gladhus <Lise.Gladhus@usn.no>
Cc: Hilde Eide <Hilde.Eide@usn.no>
Subject: Søknad om tillatelse for forskning

Hei Lise,

Jeg søker om formell tillatelse til å gjennomføre PhD prosjektet mitt og vedlagt til denne eposten finner du en formell henvendelse med kort beskrivelse av prosjektene.

Beste hilsen
H. Ösp Egilsdottir

PhD stipendiat
Klinisk veileder i G-SKUV

Høgskolen i Sørøst-Norge

Forespørsel om deltakelse i undersøkelsen:

Evaluering av Grunnleggende systematisk klinisk undersøkelse (G-SKUV) i grunnutdanningen ved Høgskolen i Sørøst Norge (HSN)

G-SKUV ble implementert i bachelorutdanningen i sykepleie ved Høgskolen i Sørøst Norge høsten 2015. Dette betyr at kull 2014, 2015, 2016 og deltidskullet 2014 har fått undervisning og praktiske øvelser knyttet til å klinisk undersøkelse. Siden undervisningsopplegget er såpass nytt er det viktig å evaluere nytten av dette konseptet for sykepleierstudenten og praksisstudier. Derfor inviteres alle studenter som studerer sykepleie, campus Drammen ved Høgskolen i Sørøst Norge å delta i evalueringen av G-SKUV.

Evalueringen vil foregå på to måter, gjennom nettbasert spørreskjema, og gruppesamtaler.

Nettbasert spørreskjema vil ta utgangspunkt i sjekklister fra G-SKUV, der det vil være svaralternativer ut i fra hvor mye du bruker hvert element av G-SKUV i praksis. I gjennomføring av spørreskjema vil en av undertegnede komme inn i kullets undervisningstime for å informere ytterligere om evalueringen og vi håper at så mange som mulig svarer på spørsmålene.

Gruppesamtalen vil ta utgangspunkt i hvilke faktorer som fremmer eller hemmer bruk av G-SKUV. Vi vil møte en gruppe fra samme kull til samtalen. Vi kommer til å bruke omlag 1 time på samtalen som vil tas opp på lydopptak, men vil slettes umiddelbart etter transkribering. Ved ønske om å delta på gruppesamtalen ber vi om at det tas kontakt med en av undertegnede.

Informert samtykke
Deltakelse i begge undersøkelsene er frivillig. Dersom du ønsker å reservere deg fra å delta i spørreundersøkelsen lar du være å logge deg på når spørreundersøkelsen blir lagt frem for klassen i undervisningstime på skolen.
Alle personidentifiserbare data vil innen prosjektslutt, 1/8-17, være anonymisert.
Spørsmål angående evalueringen kan rettes til oss via e-post: osp.egilsdottir@usn.no eller kirsten.roland.byermoen@usn.no .

Med vennlig hilsen

H.Ösp Egilsdottir
Høgskolelektor

Kirsten R. Byermoen
Høgskolelektor

Høgskolen i Sørøst-Norge

Forespørsel om deltakelse i undersøkelsen:

Evaluering av Grunnleggende systematisk klinisk undersøkelse (G-SKUV) i grunnutdanningen ved Høgskolen i Sørøst Norge (HSN)

G-SKUV ble implementert i bachelorutdanningen i sykepleie ved Høgskolen i Sørøst Norge høsten 2015. Dette betyr at kull 2015 har fått undervisning og praktiske øvelser knyttet til å klinisk undersøkelse. Siden undervisningsopplegget er såpass nytt er det viktig å evaluere nytten av dette konseptet for sykepleierstudenten og praksisstudier, gjennom flere perioder av studieforløpet. Derfor inviteres alle studenter i kull 2015 som studerer sykepleie, campus Drammen ved Høgskolen i Sørøst Norge å delta i evalueringen av G-SKUV.

Evalueringen vil foregå gjennom papirbasert spørreskjema

Spørreskjemaet vil ta utgangspunkt i sjekklister fra G-SKUV, der det vil være svaralternativer ut i fra hvor mye du bruker hvert element av G-SKUV i praksis. I gjennomføring av spørreskjema vil en av undertegnede komme inn i kullets undervisningstime 12/3 for å informere ytterligere om evalueringen og vi håper at så mange som mulig svarer på spørsmålene.

Informert samtykke
Deltakelse i undersøkelsen er frivillig. Dersom du ønsker å reservere deg fra å delta i spørreundersøkelsen unnlater du å svare på spørreskjemaet når det blir lagt frem for klassen i undervisningstime på skolen.
Alle personidentifiserbare data vil innen prosjektslutt, 1/9-18, være anonymisert.
Spørsmål angående evalueringen kan rettes til oss via e-post: osp.egilsdottir@usn.no eller kirsten.roland.byermoen@usn.no .

Med vennlig hilsen

H.Ösp Egilsdottir
Høgskolelektor

Kirsten R. Byermoen
Høgskolelektor

Vil du delta i forskningsprosjektet

«Utvikling av klinisk kompetanse ved å fokusere på og tilrettelegge for studentenes mestringstro i bruk av G-SKUV og vurderingsferdigheter i kliniske studier»

Dette er en forespørsel til deg om å delta i et forskningsprosjekt. Formålet med prosjektet er å undersøke sykepleiestudentenes egen opplevelse av kompetanse knyttet til anvendelse av Grunnleggende systematisk klinisk undersøkelse (G-SKUV) og vurderingsferdigheter. Dette skrivet inneholder informasjon om hensikten og målene for prosjektet, og hva deltakelse vil innebære for deg.

Formål
Prosjektet har som formål å utforme digitale læringsressurser som kan støtte bruk av G-SKUV i praksis og bidra til utvikling av kliniske vurderingsferdigheter. I prosjektet er det to problemstillingene som utforskes:

- Hvilken læringsstøtte trenger sykepleiestudenter som tilrettelegger for opplevelse av mestringstro og motivasjon for å bruke G-SKUV og utvikle vurderingsferdigheter i klinisk praksis?
- Hvordan opplever sykepleiestudenter å være en del av studentaktivt samarbeid ved utvikling av digitale læringsressurser i sykepleierutdanningen?

Et viktig element i prosjektet er studentaktive forskningsmetoder. Det innebærer at studentene som er brukerne av digitale læringsressursene inviteres inn i prosjektet for å påvirke og ha innflytelse på innholdet og utformingen av digitale læringsressursene. Vi inviterer derfor deg som sykepleiestudent til å bli med fordi du er en viktige samarbeidspartner. Dine meninger og ideer knyttet til hvordan et nettbasert læringsverktøy kan imøtekomme studentenes læringsbehov i klinisk praksis er viktig element i dette prosjektet.

Hvem er ansvarlig for forskningsprosjektet?
Prosjektleder og hovedveileder er professor Hilde Eide ved Universitetet i Sørøst-Norge. Det er også to biveiledere i prosjektgruppen, professor Anne Moen ved Universitetet i Oslo og førsteamanuensis Lena Heyn ved Universitetet i Sørøst-Norge. IT selskapet Conexus, som er spesialister på kompetansekartlegging, læringsbehov og profesjonell læring i utdannings- og privatsektoren, er også en viktig samarbeidspartner. Conexus sitt bidrag i prosjektet vil først og fremst handle om digitalisering av kartleggingsverktøy og IT plattform rettet mot kompetanseutvikling og læringsbehov.

Hvorfor får du spørsmål om å delta?
Du blir invitert til å delta fordi du er student ved USN, campus Drammen, hvor G-SKUV er implementert som arbeidsmetode i kliniske studier for sykepleierstudenter.

Fakultet for Helse- og sosialvitenskap støtter dette prosjektet, og har derfor gitt sin tillatelse for invitasjonen til forskningsprosjektet og at du som student får den tilsendt til USN eposten.

Hva innebærer det for deg å delta?
Forskningsmetoden som anvendes i prosjektet kalles for deltakende design (Participatory design). Ved å bruke denne metoden er forskeren en aktiv deltaker sammen med dere som deltakende studenter. Hvis du velger å delta i prosjektet, innebærer det deltakelse på tre workshops hvor alle deltagere møtes for å diskutere behov og ideer angående utforming av de digitale læringsressursene. I tiden mellom workshopene kan deltakerne teste ut de forskjellige løsningsforslagene og gi tilbakemeldinger på disse på neste workshop. Diskusjonene i workshopene vil bli tatt opp på bånd for å sikre at alle ideer og løsninger kommer med videre. Lydopptakene blir gjennomgått etter workshopene for å finpusse notater som gjøres underveis. Det kan også være aktuelt å ta bilder av materialet som produseres på workshopene. For eksempel tegninger og notater på tavle. Det blir ikke tatt bilder av deltakerne.

Etter de tre workshopene blir det gjennomført et fokusgruppeintervju, der hensikten er å samle mer data knyttet til problemstillingene i prosjektet:

- Hvilken læringsstøtte trenger sykepleiestudenter som tilrettelegger for opplevelse av mestringstro og motivasjon for å bruke G-SKUV og utvikle vurderingsferdigheter i klinisk praksis?
- Hvordan opplever sykepleiestudenter å være en del av studentaktivt samarbeid ved utvikling av digitale læringsressurser i sykepleierutdanningen?

Intervjuet blir tatt opp på bånd, analysert og anonymisert.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke deg uten å oppgi noen grunn. Alle opplysninger om deg vil bli avidentifisert. Det vil ikke ha noen konsekvenser for deg og dine studier hvis du ikke vil delta eller om du velger å trekke deg på et senere tidspunkt.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har beskrevet i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Det vil bare være prosjektgruppen (Phd stipendiat og veiledningsgruppen) som har tilgang til datamaterialet med spørreskjemaer og transkriberte lydopptak. Alt av datamateriale blir oppbevart på en sikker server ved Universitet i Sørøst-Norge. Dataene vil bli anonymisert, og det vil ikke være mulig å gjenkjenne deltakere i prosjektet ved fremstilling av resultater i publikasjoner og presentasjoner.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Prosjektet skal etter planen avsluttes 31.12 2022 og alt av innhentet datamateriale anonymiseres innen utgangen av 2025.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og

- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke. På oppdrag fra Universitetet i Sørøst-Norge har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Universitet i Sørøst-Norge ved stipendiat H. Ösp Egilsdottir epost: osp.egilsdottir@usn.no mobil: 94886406, eller prosjektleder Hilde Eide epost: hilde.eide@usn.no mobil: 48243096
- Vårt personvernombud: Paal Are Solberg personvernombud@usn.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Professor Hilde Eide
Prosjektleder og hovedveileder

H. Ösp Egilsdottir
Stipendiat

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet **«Utvikling av klinisk kompetanse ved å fokusere på og tilrettelegge for studentenes mestringstro i bruk av G-SKUV og vurderingsferdigheter i kliniske studier»**, og har fått anledning til å stille spørsmål.

Jeg samtykker til:

- ☐ å delta i workshop for å utforme innholdet i digitale læringsressurser
- ☐ å delta i fokusgruppeintervju knyttet til workshop

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 31.12 2022

(Signert av prosjektdeltaker, dato)

Vil du delta i forskningsprosjektet:

«Grunnleggende Systematisk Klinisk Undersøkelse og vurderingsferdigheter (G-SKUV)»

Dette er en forespørsel til deg om å delta i et forskningsprosjekt knyttet til sykepleierutdanningen ved Universitet i Sørøst-Norge (USN) campus Drammen. Dette skrivet inneholder informasjon om hensikten for prosjektet og hva deltakelse vil innebære for deg.

Formål
På USN campus Drammen har G-SKUV vært en del av faginnholdet i sykepleierutdanningen siden 2015. Våren 2019 samarbeidet lærere og sykepleiestudenter om å utvikle digitale læringsressurser som kan være nyttige når studenter skal anvende G-SKUV i forskjellige praksisperioder i kommunen og i sykehus. Vi vil spesielt undersøke om digitale læringsressursene påvirker utvikling av kompetanse og ferdigheter knyttet til gjennomføring av G-SKUV. I tillegg undersøkes faglige kunnskaper som G-SKUV baserer seg på. Denne studien er en del av forskningsaktivitetene som pågår ved USN for å kontinuerlig forbedre sykepleierutdanningen.

Hvem er ansvarlig for forskningsprosjektet?
Prosjektleder og hovedveileder er professor Hilde Eide ved USN. Det er også to biveiledere i prosjektgruppen fra USN, professor II Anne Moen og førsteamanuensis Lena Heyn. Fakultet for Helse- og sosialvitenskap støtter dette prosjektet og har derfor gitt sin tillatelse for behandling av personopplysninger i forskningsprosjektet.

Hvorfor får du spørsmål om å delta?
Du blir invitert til å delta fordi du er student ved USN, campus Drammen, hvor G-SKUV anses å være viktig kompetanse når pasienter skal observeres og vurderes for å avklare behov for helsehjelp. Alle sykepleiestudenter ved USN campus Drammen får forespørselen om å delta i dette forskningsprosjektet.

Hva innebærer det for deg å delta?
Samtykke til deltakelse i forskningsprosjektet innebærer:

- at du får tilgang til de digitale læringsressursene i *en* (medisinsk/kirurgisk) praksisperiode i spesialisthelsetjenesten i andre studieår
- at du får mer interaktive studieoppgaver i praksisperioden (refleksjonsoppgave)
- at du vil få to spørreskjemaer å svare på, ved oppstart og avslutning av praksisperioden

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Om du *ikke* ønsker å delta i prosjektet eller om du ønsker å trekke samtykket ditt tilbake, gjøres skriftlig til emneleder Jill Flo (jill.flo@usn.no) for det aktuelle praksisemnet. Det vil ikke ha noen negative konsekvenser for deg og vurdering av praksisperioden, hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi bruker opplysningene om deg og din deltakelse til formålene vi har beskrevet i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Det er Phd stipendiat og veiledere som har tilgang til datamaterialet. Spørreskjemaet på slutten av utdanningsåret anvendes også i andre forskningsprosjekter ved sykepleierutdanningen, og anonymiserte data fra dette forskningsprosjekt vil sammenliknes med deltakere i de andre studiene ved USN.
Alt av datamateriale blir oppbevart på en sikker server ved USN. Læringsplattformen Canvas blir benyttet for digitale læringsressursene som innebærer at datamateriale blir ivaretatt av databehandlingsavtale mellom USN og Canvas. Bakgrunnsdata (for eksempel alder, nasjonalitet og morsmål) og forøvrige dataene som blir samlet inn i studien blir avidentifisert og det vil ikke være mulig å gjenkjenne deltakere i prosjektet ved fremstilling av resultater i publikasjoner og presentasjoner.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Prosjektet skal etter planen avsluttes 31.12 2022 og alt av innhentet datamateriale anonymiseres innen utgangen av 2027.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke. På oppdrag fra Universitetet i Sørøst-Norge har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:
- Universitet i Sørøst-Norge ved stipendiat H. Ösp Egilsdottir epost: osp.egilsdottir@usn.no mobil: 94886406, eller prosjektleder Hilde Eide epost: hilde.eide@usn.no mobil: 48243096
- Vårt personvernombud: Paal Are Solberg personvernombud@usn.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Professor Hilde Eide
Prosjektleder og hovedveileder

H. Ösp Egilsdottir
Stipendiat

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «Grunnleggende Systematisk Klinisk Undersøkelse og vurderingsferdigheter (G-SKUV)», og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å bruke og evaluere digitale læringsressursene som støtter G-SKUV ferdigheter i *en* praksisperiode (enten medisinsk eller kirurgisk) i andre studieår
- ☐ å delta i spørreundersøkelse i starten og slutten av *en* praksisperiode (høst 2019/vår 2020)
- ☐ å gi tilgang til karakterer i naturvitenskapelige fag

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 31.12 2022 og at datamaterialet oppbevares frem til utgangen av 2027.

(Signert av prosjektdeltaker, dato)

(navn blokkbokstaver)

Vil du delta i forskningsprosjektet:

«Grunnleggende Systematisk Klinisk Undersøkelse og Vurderingsferdigheter (G-SKUV)»

Dette er en forespørsel til deg om å delta i et forskningsprosjekt knyttet til sykepleierutdanningen ved Universitet i Sørøst-Norge (USN) campus Drammen. Dette skrivet inneholder informasjon om hensikten for prosjektet og hva deltakelse vil innebære for deg.

Formål
På USN campus Drammen har G-SKUV vært en del av faginnholdet i sykepleierutdanningen siden 2015. Våren 2019 samarbeidet lærere og sykepleiestudenter om å utvikle digitale læringsressurser som kan være nyttige når studenter skal anvende G-SKUV i forskjellige praksisperioder i kommunen og i sykehus. Vi vil spesielt undersøke om digitale læringsressursene påvirker utvikling av kompetanse og ferdigheter knyttet til gjennomføring av G-SKUV. I tillegg undersøkes faglige kunnskaper som G-SKUV baserer seg på. Denne studien er en del av forskningsaktivitetene som pågår ved USN for å kontinuerlig forbedre sykepleierutdanningen.

Hvem er ansvarlig for forskningsprosjektet?
Prosjektleder og hovedveileder er professor Hilde Eide ved USN. Det er også to biveiledere i prosjektgruppen fra USN, professor II Anne Moen og førsteamanuensis Lena Heyn. Fakultet for Helse- og sosialvitenskap støtter dette prosjektet, og har derfor gitt sin tillatelse for invitasjonen til forskningsprosjektet.

Hvorfor får du spørsmål om å delta?
Du blir invitert til å delta fordi du er student ved USN, campus Drammen, hvor G-SKUV anses å være viktig kompetanse når pasienter skal observeres og vurderes for å avklare behov for helsehjelp. Alle sykepleiestudenter ved USN campus Drammen får forespørselen om å delta i dette forskningsprosjektet.

Hva innebærer det for deg å delta?
Samtykke til deltakelse i forskningsprosjektet innebærer:

- at du får tilgang til de digitale læringsressursene i praksisperioden knyttet til hjemmebaserte tjenester i tredje studieår
- at du får mer interaktive studieoppgaver i praksisperioden som erstatter tradisjonelle skriftlige oppgaver
- at du vil få spørreskjema å svare på, ved oppstart og avslutning av praksisperioden

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Om du *ikke* ønsker å delta i prosjektet eller om du ønsker å trekke samtykket ditt tilbake, gjøres skriftlig til emneleder Patricia P. Rostad (patricia.p.rostad@usn.no) for aktuelle praksisemnet. Det vil ikke ha noen negative konsekvenser for deg og vurdering av praksisperioden, hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi bruker opplysningene om deg og din deltakelse til formålene vi har beskrevet i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Det er Phd stipendiat og veiledere som har tilgang til datamaterialet. Spørreskjemaet på slutten av utdanningsåret anvendes også i andre forskningsprosjekter ved sykepleierutdanningen, og anonymiserte data fra dette forskningsprosjekt vil sammenliknes med deltakere i de andre studiene ved USN.
Alt av datamateriale blir oppbevart på en sikker server ved USN. Læringsplattformen Canvas blir benyttet for digitale læringsressursene som innebærer at datamateriale på Canvas blir ivaretatt av databehandlingsavtale mellom USN og Canvas. Bakgrunnsdata (for eksempel alder, nasjonalitet og morsmål) og forøvrige dataene som blir samlet inn i studien blir avidentifisert og det vil ikke være mulig å gjenkjenne deltakere i prosjektet ved fremstilling av resultater i publikasjoner og presentasjoner.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Prosjektet skal etter planen avsluttes 31.12 2022 og alt av innhentet datamateriale anonymiseres innen utgangen av 2027.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:
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- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke. På oppdrag fra Universitetet i Sørøst-Norge har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:
- Universitet i Sørøst-Norge ved stipendiat H. Ösp Egilsdottir epost: osp.egilsdottir@usn.no mobil: 94886406, eller prosjektleder professor Hilde Eide epost: hilde.eide@usn.no mobil: 48243096
- Vårt personvernombud: Paal Are Solberg personvernombud@usn.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Professor Hilde Eide
Prosjektleder og hovedveileder

H. Ösp Egilsdottir
Stipendiat

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «Grunnleggende Systematisk Klinisk Undersøkelse og vurderingsferdigheter (G-SKUV)», og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å bruke og evaluere digitale læringsressursene som støtter G-SKUV ferdigheter i praksisperiode knyttet til hjemmebaserte tjenester i tredje studieår
- ☐ å delta i spørreundersøkelse i starten og slutten av praksisperiode knyttet til hjemmebaserte tjenester som foregår høst 2019 eller vår 2020
- ☐ å gi tilgang til karakterer i naturvitenskapelige fag

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 31.12 2022 og at datamaterialet oppbevares frem til utgangen av 2027.

(Signert av prosjektdeltaker, dato)

(navn blokkbokstaver)

Informasjon om forskningsprosjektet:

DIGITAL UNDERVISNINGSPRAKSIS

Dette er en forespørsel til deg om å delta i et forskningsprosjekt ved sykepleierutdanningen ved Universitet i Sørøst-Norge (USN), campus Drammen. Dette skrivet inneholder informasjon om hensikten med prosjektet og hva deltakelse vil innebære for deg.

Formål
COVID-19 pandemien fører til store endringer for studenter og ansatte i sykepleierutdanningen ved Universitetet i Sørøst-Norge. Studenter i første studieår som skulle ut i klinisk praksis etter påske vår 2020 vil få tilbud om et strukturert digital undervisningspraksis med fokus på skriftlige oppgaver og digitale læringsressurser. På USN campus Drammen har Grunnleggende systematisk klinisk undersøkelse og vurdering (G-SKUV) vært en del av faginnholdet i sykepleierutdanningen siden 2015. Våren 2019 samarbeidet lærere og sykepleiestudenter om å utvikle digitale læringsressurser som kan være nyttige når studenter skal anvende G-SKUV i forskjellige praksisperioder i kommunen og i sykehus. Disse digitale ressursene vil nå være en del av PGS10. Vi ønsker å undersøke hvordan studentene erfarer og lærer i dette endrede studietilbudet. Vi vil spesielt undersøke hvordan digital undervisningspraksis sammen med digitale læringsressurser påvirker kompetanse- og kunnskapsutvikling knyttet til læringsutbyttebeskrivelsene i PGS10. I tillegg undersøkes faglige kunnskaper som G-SKUV baserer seg på.
Denne studien er en del av forskningsaktivitetene som pågår ved USN for å kontinuerlig forbedre sykepleierutdanningen.

Hvem er ansvarlig for forskningsprosjektet?
Dette er en del av mitt PhD prosjekt. Prosjektleder og hovedveileder er professor Hilde Eide ved USN. Andre ansatte ved USN som deltar i forskningsprosjektet er førsteamanuensis Lena Heyn og universitetslektorene Espen Brembo og Kirsten Røland Byermoen. Fakultet for Helse- og sosialvitenskap støtter dette prosjektet og har derfor gitt sin tillatelse for invitasjonen til forskningsprosjektet.

Hvorfor får du spørsmål om å delta?
Du blir invitert til å delta fordi du er student ved USN, campus Drammen og registrert som student i praksisemnet PGS10 som innebærer et alternativt undervisningopplegg i stedet for før vanlig klinisk praksis.

Hva innebærer det for deg å delta?
Alle studentene i PGS10 får:

- Tilgang til de digitale læringsressursene som en del av alternativt undervisningspraksis
- Praksisnære læringsaktiviteter som erstatter tradisjonelle praksisoppgaver og erfaringer
- Et strukturert forelesnings- og refleksjonsforum via Zoom som vil tas opp, slik at det også er tilgjengelig for studenter i gruppesimuleringen som av en eller annen grunn ikke kan følge undervisningen på de oppsatte tidene (dvs. at den digitale undervisningspraksisen i canvasrommet blir tatt opp på video med lyd og eventuelt bilde).

Samtykke til deltakelse i forskningsprosjektet innebærer:

- At du gir tillatelse til at undervisningen og det materialet som er beskrevet over kan anvendes i forskning og
- At du blir invitert til gruppesamtale der du kan dele dine erfaringer med dette alternative digitale lærings- og undervisningstilbudet og
- Du vil få tilsendt digitale spørreskjemaer knyttet til å evaluere digitale undervisningspraksisen.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Om du ikke ønsker å delta i prosjektet eller om du ønsker å trekke samtykket ditt tilbake, gjøres det skriftlig til emneleder Elise Eriksen (elise.eriksen@usn.no) når som helst i løpet av uke 16-24. Det vil ikke ha noen konsekvenser for deg og vurdering av læringsaktivitetene i løpet av alternative praksisukene, hvis du ikke vil delta eller senere velger å trekke deg. Dette betyr at forskerne ikke er involverte i evalueringer av studieoppgavene.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi bruker opplysningene om deg og din deltakelse til formålene vi har beskrevet i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Det er Phd stipendiat og veiledere/forskergruppen som har tilgang til datamaterialet. Alt av datamateriale blir oppbevart på en sikker server ved USN. Læringsplattformen Canvas blir benyttet for de digitale læringsressursene som innebærer at datamateriale knyttet til Canvas blir ivaretatt av databehandlingsavtale mellom USN og Canvas. Bakgrunnsdata (for eksempel alder, nasjonalitet og morsmål) og forøvrige data som blir samlet inn i studien vil bli avidentifisert og det vil ikke være mulig å gjenkjenne deltakere i prosjektet ved fremstilling av resultater i publikasjoner og presentasjoner.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Prosjektet skal etter planen avsluttes 31.12 2022 og alt av innhentet datamateriale anonymiseres innen utgangen av 2027.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- Innsyn i hvilke personopplysninger som er registrert om deg,
- Å få rettet personopplysninger om deg,
- Få slettet personopplysninger om deg,
- Få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- Å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke. På oppdrag fra Universitetet i Sørøst-Norge har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Universitet i Sørøst-Norge ved stipendiat H. Ösp Egilsdottir epost: osp.egilsdottir@usn.no mobil: 94886406, eller prosjektleder professor Hilde Eide epost: hilde.eide@usn.no mobil: 48243096
- Vårt personvernombud: Paal Are Solberg personvernombud@usn.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Professor Hilde Eide
Prosjektleder og hovedveileder

H. Ösp Egilsdottir
Stipendiat

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «Digital undervisningspraksis» og har fått anledning til å stille spørsmål.

Jeg samtykker til:

- ☐ Å evaluere digitale undervisningspraksisen
- ☐ Å gi tillatelse til at informasjon om læringsaktivitetene i canvasrommet brukes til forskning
- ☐ Å delta i spørreundersøkelse i slutten digital undervisningspraksis

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 31.12 2022 og at datamaterialet oppbevares frem til utgangen av 2027.

(Signert av prosjektdeltaker, dato)

(navn blokkbokstaver)

University of South-Eastern Norway

Informasjon om forskningsprosjektet:

DIGITAL UNDERVISNINGSPRAKSIS

Dette er en forespørsel til deg om å delta i et forskningsprosjekt ved sykepleierutdanningen ved Universitet i Sørøst-Norge (USN), campus Drammen. Dette skrivet inneholder informasjon om hensikten med prosjektet og hva deltakelse vil innebære for deg.

Formål
COVID-19 pandemien fører til store endringer for studenter og ansatte i sykepleierutdanningen ved Universitetet i Sørøst-Norge. Studenter i første studieår som skulle ut i klinisk praksis (emne PGS10) etter påske vil få tilbud om en strukturert digitalt undervisningspraksis med skriftlige oppgaver og forskjellige digitale læringsressurser, blant annet digital simulering.
Vi ønsker å undersøke hvordan praksislærere erfarer å følge opp og veilede studenter i digital undervisningspraksis. Vi vil spesielt undersøke hvordan digital simulering oppleves som alternativ læringsaktivitet for klinisk praksis og hvordan gruppesimulering via Zoom erfares som refleksjonsforum for studentenes kunnskapsutvikling.

Hvem er ansvarlig for forskningsprosjektet?
Studien er en del av et PhD prosjekt. Prosjektleder og hovedveileder er professor Hilde Eide ved USN. Andre ansatte ved USN som deltar i forskningsprosjektet er førsteamanuensis Lena Heyn og universitetslektorene Espen Brembo og Kirsten Røland Byermoen. Fakultet for Helse- og sosialvitenskap støtter dette prosjektet og har derfor gitt sin tillatelse for invitasjonen til forskningsprosjektet.

Hvorfor får du spørsmål om å delta?
Du blir invitert til å delta fordi din rolle som praksislærer ved USN, campus Drammen i emnet PGS10 og følger opp studenter i digital undervisningspraksis.

Hva innebærer det for deg å delta?
En del av praksislærerens rolle i digitale undervisningspraksisen er å følge opp studenter i digital simulering i gruppe via Zoom. Det vil bli gjort opptak av lyd og bilde av denne læringsaktiviteten som gjøres tilgjengelig for studenter som av en eller annen grunn ikke kan følge undervisningen i sanntid.

Samtykke til deltakelse i forskningsprosjektet innebærer:

- at du samtykker at opptak av digital simulering som legges ut i Canvas kan brukes til forskning
- at du vil bli invitert til å delta i gruppesamtale/alternativt individuell samtale online via Zoom der du kan dele dine erfaringer med å følge opp studenter i digital undervisningspraksis og
- at du vil få tilsendt et digitalt spørreskjema for å evaluere den digitale simuleringen som du velger om du vil svare på.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Samtykket i denne studien gis ved at du deltar i digital simulering via Zoom, at du er med i online gruppesamtale og svarer på spørreskjemaet.

University of South-Eastern Norway

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi bruker opplysningene om deg og din deltakelse til formålene vi har beskrevet i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Det er Phd stipendiat og veiledere/forskergruppen som har tilgang til datamaterialet. Alt av datamateriale blir oppbevart på en sikker server ved USN. Data som blir samlet inn i studien vil bli avidentifisert og det vil ikke være mulig å gjenkjenne deltakere i prosjektet ved fremstilling av resultater i publikasjoner og presentasjoner.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Prosjektet skal etter planen avsluttes 31.12 2022 og alt av innhentet datamateriale anonymiseres innen utgangen av 2027.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:

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- å få rettet personopplysninger om deg,
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Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Universitet i Sørøst-Norge ved stipendiat H. Ösp Egilsdottir epost: osp.egilsdottir@usn.no mobil: 94886406, eller prosjektleder professor Hilde Eide epost: hilde.eide@usn.no mobil: 48243096
- Vårt personvernombud: Paal Are Solberg personvernombud@usn.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

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Professor Hilde Eide
Prosjektleder og hovedveileder

H. Ösp Egilsdottir
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