ERASMUS MUNDUS JOINT MASTER'S DEGREE IN EMERGENCY AND CRITICAL CARE NURSING (EMJMD NURSING)

The effectiveness of computer-based gaming simulation on nursing students' knowledge and confidence: A randomized controlled trial

Gdiom Gebreheat Abady

8/02/2022

Master´s Thesis

ERASMUS MUNDUS JOINT MASTER'S DEGREE IN EMERGENCY AND CRITICAL CARE NURSING (EMJMD NURSING)

Author	Supervisor	Co-supervisor
Gdiom Gebreheat Abady	Dr. Ruth Paterson (PhD, MPhil, FHEA, RN Associate Professor, Head of Nursing, Honorary Research Consultant NHS Lothian, School of Health and Social Care, Edinburgh Napier University)	Jane Whitehorn BN, BSc (Hons), MSc, Specialist Practitioner in Critical Care Nursing, RN (Adult), FHEA Programme Leader for MSc Nursing (Pre-registration) Lecturer in Adult Nursing, School of Health and Social Care, Edinburgh Napier University

CERTIFY:

That the Master's Thesis submitted by Gdiom Gebreheat, entitled **the effectiveness of computer-based gaming simulation on nursing students' knowledge and confidence: A randomized controlled trial** carried out under our supervision in the Erasmus Mundus Joint Master's Degree in Emergency and Critical Care Nursing, meets the necessary requirements to be approved as a Master´s Thesis.

And for the record, and for the relevant purposes, the present certification is issued in Edinburgh on 8/02/2022.

MASTER'S THESIS SUPERVISOR

Dr. Ruth Paterson

CO-SUPERVISOR

Jane Whitehorn

Edinburgh Napier UNIVERSITY

The effectiveness of computer-based gaming simulation on nursing students' knowledge and confidence: A randomized controlled trial

BY: Gdiom Gebreheat Abady

Matriculation number: 40520611

A dissertation submitted in partial fulfilment of the requirements of Edinburgh Napier University for the Erasmus Mundus Joint Master's Degree in Emergency and Critical Care Nursing

February 2022

Abstract

Background: The current pandemic, COVID-19 disease, is a highly contagious viral infection caused by novel coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). For this reason, the Nursing and Midwifery Council have placed greater emphasis on digital simulated learning activities, yet it is not clear whether it is as an effective learning opportunity as on campus simulation.

Aim: To evaluate the effectiveness of computer-based gaming simulation on nursing students' knowledge and confidence in Sighthill campus, Edinburgh Napier University, United Kingdom, 2021

Methods: A randomized controlled trial was carried out with 67 undergraduate nursing students between September 2021 and November 2021. Students were randomly assigned to either the computer-based COVID-19 gaming simulation (experimental group) or manikin-based face-to-face COVID-19 simulation (control group). An independent-samples T test and a paired-samples T test performed to detect mean differences (MD) between groups and within a group, respectively, at $p < 0.05$ and 95% confidence interval (CI).

Results: The mean knowledge score for the participants in the control group was significantly higher than the intervention group, 21.4 $\pm$ 1.6 and 19.8$\pm$ 2.1, respectively. A significant statistical difference for confidence was observed between pretest and posttest in the control group, (MD=-0.88, 95% CI (-1.1, -0.6)). The anxiety level of the students in the control group decreased from pretest (2.6 ± 0.6) to post (2.0 ± 0.5), MD=0.55, 95% CI (0.3, 0.7).

Conclusion: Overall, computer-based gaming simulation was not as effective as the manikin-based simulation in improving student nurses' self-efficacy and knowledge acquisition. The manikin-based face-to-face simulation was superior to the computer-based gaming simulation in knowledge acquisition. In the computer-based gaming simulation, whilst there were improvements in self-confidence and anxiety levels, there were no significant statistical differences between pre and posttests. Therefore, computer-based gaming could be an adjunct simulation in situations where in-person simulation is not possible.

Table of contents

List of figures

List of tables

Acknowledgment

I would like to thank Erasmus Mundus joint master's degree in emergency and critical care nursing (EMJMD NURSING) program hosting Universities (University of Oviedo, University of Algarve, IPSantarem and Edinburgh Napier University) for giving me the opportunity to pursue my education. I also would like to express my deepest gratitude to my supervisor Professor Ruth Paterson (PhD) for her unreserved supports and excellent guidance during the whole process to this research. I would not also attend this prestigious program without the financial support by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission.

I am also very glad to forward my special thanks for unlimited assistance of the School of Health and Social Care, SightHill Campus, Edinburgh Napier University. The hospitality and cooperation of the population of the study site in general, and the study participants in particular are highly appreciated. Last but not least I am also very glad to forward my special thanks to all my friends who had contributions to achieve this research project.

Chapter 1 - Introduction

1.1 Background

The current pandemic, COVID-19 disease, is a highly contagious viral infection caused by novel coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Person-to-person spread is the main means of transmission, when any infected person sneeze or cough respiratory droplets of the virus, and these droplets enter the lungs of a nearby person via inhalation. Besides, environmental contamination is another way to spread the virus, resulting in an unprecedented threat to global health and well-being. Patients infected from SARS-CoV-2 infection often presented with dry cough, fever, sputum production and shortness of breath and upper airway congestion (Jin, Yuefei and Yang, Haiyan and Ji, Wangquan and Wu, Weidong and Chen, Shuaiyin and Zhang, Weiguo and Duan, 2020; Tsang et al., 2021).

In a pre-COVID era, health care workers would have been prepared to care for this population in a face-to-face simulated environment: an educational approach known to have a favourable effect on patient outcomes. Also, the corona pandemic has posed challenges for health teaching with simulated persons, which usually requires the physical presence of the participants. During lockdown this was impossible and alternative approaches to simulation education were developed. The pandemic shortened the time of transformation from a real clinical setting to a digital environment (Peisachovich et al., 2020; Peters & Thrien, 2020). One of the emerging digital simulation methods is computer-based simulation, which is believed to be effective in improving communication, knowledge and self-efficacy of nursing students (Choi et al., 2020). Particularly, games have shown positive results regarding effectiveness and usability in nursing education system. Videogames in nursing education system identified potential benefits for motivation, decision-making, repeated exposure, financial and logistical value (Pront et al., 2018).

A team at Edinburgh Napier University were approached by NHS Education for Scotland create a national online resource for early recognition and treatment of a person acutely unwell with suspected COVID-19. Similar to simulation, serious games can promote learning in a safe learning environment and allow the player to develop knowledge skills and confidence through trial and error (Martí-Parreño et al., 2016). Immediate feedback improves the precise understanding of the subject area and is viewed a valuable educational approach (Connolly, Thomas and Stansfield, 2007).

1.2 Theoretical foundation of the COVID-19 game

More recently, because of the COVID-19 pandemic, clinical hours are being replaced by digital simulations (Verkuyl et al., 2021). One of the most being used digital simulation is 3D game. Serious games are computer-based simulations that combine knowledge and skills development with video game-playing aspects to enable active, experiential, situated, and problem-based learning (Johnsen et al., 2018). Optimistic results are found on nursing students' experiences of successful learning through playing a 3D simulation games (Koivisto et al., 2016).

1.3 Justification of the study

The impact of interactive online simulation is novel and its impact on learning is not well evidenced in literature. The Nursing and Midwifery Council have placed greater emphasis on simulated learning activities, yet it is not clear whether digital simulation is as an effective learning opportunity as on campus simulation (Murray et al., 2008). This study will test hypotheses that digital scenarios are as effective as on campus simulation. This project is of global interest because if proven it will support low- and middle-income countries to implement digital learning experience into their curriculum. Online learning has increased since the COVID pandemic and its flexibility for student has been beneficial, it is important to explore the impact of this educational approach from the perspective of the learner. Through dissemination of findings through conference and journal presentations the study will add to the evidence base of this educational approach. The study may provide stimulus for future work in this area including development of providing further evidence of its continued use.

1.4 Research question

Is digital simulation as effective as on campus simulation: a knowledge acquisition and self-efficacy.

1.5 Research hypotheses

1. There will be a difference in knowledge acquisition between student nurses who playing computer-based gaming simulation and undertaking manikin-based face-to-face simulation.
2. There will be a difference in self-efficacy between student nurses who playing computer-based gaming simulation and undertaking manikin-based face-to-face simulation.
3. There will be a difference in self-efficacy of student nurses before and after playing computer-based gaming simulation.

4. There will be a difference in self-efficacy of student nurses before and after undertaking manikin-based face-to-face simulation.

Chapter 2 - Integrative review of literature

2.1 Introduction

Simulation is believed to be a means for bridging the theory-practice gap in the nursing education system (Lavoie et al., 2018). A skill laboratory-based simulation has been served a well embedded teaching-learning strategy to fill the gap between theory and skill performance. Nowadays, digital simulation is an advancing innovation with the potential to manage the limitations to traditional clinical simulation (Rourke, 2020).

The COVID-19 pandemic has posed challenges for skill laboratory teaching with simulated persons which usually requires the physical presence of the students (Peters & Thrien, 2020). On the other side, the pandemic has also dramatically impacted the rise of e-learning, whereby teaching is undertaken without contact and on digital platforms. The resultant has extensively impacted colleges and higher education institutions around the world. One way to support the education delivery system in nursing is by harmonizing virtual simulation approaches with the existing face-to-face clinical simulation (Peisachovich et al., 2020).

Hence, if the digital simulation is to be incorporated in the nursing education as an effective adjunct to face-to-face clinical simulation, it should be supported and proved by primary and secondary studies. Therefore, before primary research is undertaken, the nature and quality of existing literature relating to computer-based simulation should be investigated. Moreover, evidence is important to evaluate if the computer -based simulation is effective on the nursing students' knowledge acquisition, increasing self-confidence and decreasing anxiety level in comparison to the face-to-face clinical simulation.

2.2 Material and methods

2.2.1 Design

We adopted an integrative review approach as it allow inclusion of articles with diverse methods to be applied to clinical practices and evidence-based practice initiatives (Whittemore & Knafl, 2005). Also, the article selection procedure guided with Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) (Moher, David and Liberati, Alessandro and Tetzlaff, Jennifer and Altman, 2009).

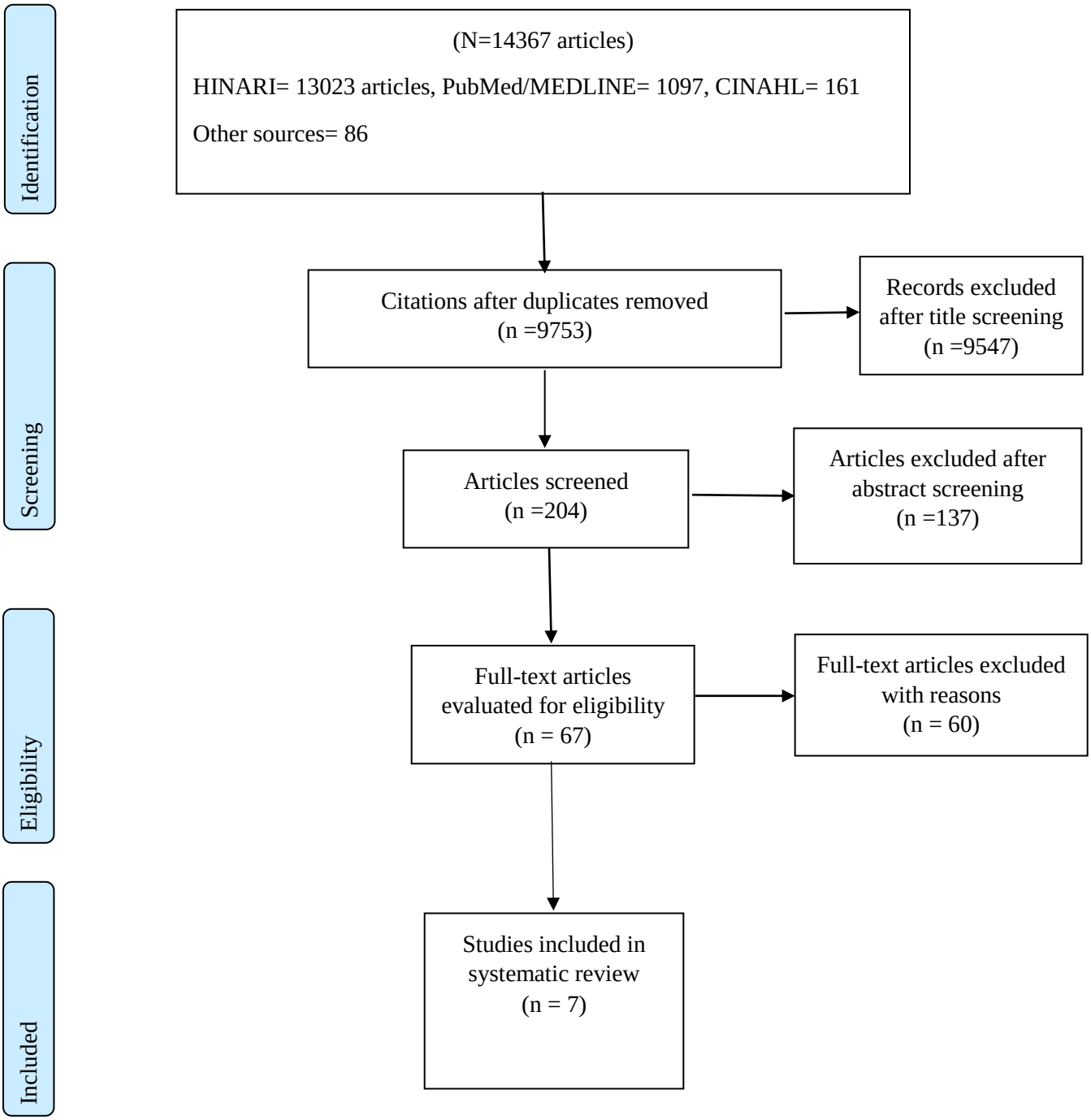

Figure 1. A PRISMA flow chart that shows the process of article selection.

2.2.2 Search strategy

Literature that reported the effectiveness of digital simulation on nursing students' knowledge and/or confidence were included from various electronic databases. The electronic database search carried out between October 03, 2021 and October 7, 2021. Subsequently, we have searched articles in PubMed, SCOPUS, Edinburgh Napier University databases, HINARI, Web of Science, African Index Medicus (AIM), SCOPUS, Cumulative Index to Nursing and Allied Health Literature (CINAHL) (EBSCOhost), WHO's Institutional Repository for Information Sharing (IRIS) and African Journals Online databases. In addition, articles were included through a review of the grey literature available in google databases and a review of the reference lists of identified articles.

The main terms used during electronic database search were: ("Simulation" AND Nurs* AND "Student*" AND ("knowledge" OR "Confidence")). Please see (Appendix I) for a detail article searching strategies, terms used in each database and search results.

2.2.3 Eligibility criteria

Table 1 . Inclusion and exclusion criteria for articles

Inclusion criteria	**Exclusion criteria**
• All English-language studies that reported the effectiveness of digital simulation on nursing students' knowledge and/or confidence were eligible for the review. • Both qualitative and quantitative studies are included in the review. • To reach on up-to-date conclusion, our searching strategy was limited to articles published between January 2012 and October 2021.	• Non-primary sources such as editorials, opinion pieces, letters and review papers are excluded. • Articles dealing with multidisciplinary professionals were not eligible for review unless they show a sub-group analysis that meets the objective of our review. • We excluded articles that were inaccessible following three e-mail contacts with the principal investigator.

• Further, articles should clearly address that the participants were nursing students.	• More importantly, the decision whether to include an article was based on the consensus of the two authors.

2.2.4 Selection of studies

All database search results exported to the Mendeley reference manager software version 1.19.4. With the help of the software, duplicate search results are removed. Subsequently, a two-step article selection process carried out. In step 1, two independent reviewers scanned the titles and abstracts of all articles reporting on the effectiveness of digital simulation on nursing students' knowledge and/or confidence. And in step 2, full-text articles screened by the reviewers to determine their eligibility. In the end, fully eligible articles selected for further analysis (Figure 1).

2.2.5 Data extraction, analysis, and synthesis

The framework of integrative review by Whittemore and Knafl directed the data extraction, analyses and synthesis (Whittemore & Knafl, 2005). Initially, we read the articles at least three times to grasp a comprehensive understating of the methodology and findings. Based on this, we identified the common observations and patterns in each article. Next, we abstracted variables that were considered as important measure of the effectiveness of digital simulation on nursing students' knowledge and/or confidence. Consequently, we recorded the author, year of publication, study setting, design, purpose and main findings of each article.

With regard to analysis, all articles that meet the eligibility criteria categorized based on the study design, objective, sample size and primary outcome measurements. Finally, the result synthesized based on the study characteristics and the main outcomes of our research question. Basically, our synthesis focused on the effectiveness of computer-based simulation on student nurses' self-confidence, anxiety and knowledge acquisition in comparison to face-to face or traditional simulation.

2.2.6 Quality assessment

The methodological quality of the papers evaluated using the JBI quality assessment checklists for quasi-experimental, randomized controlled trial and qualitative research ("JBI Manual for

Evidence Synthesis," 2020; Moola et al., 2017; The Joanna Briggs Institute, 2017) (Appendix II, III & IV).

2.3 Result

2.3.1 Study selection and characteristics

A PRISMA flowchart was used to demonstrate the process of article selection and inclusion for the review. Accordingly, we found 14367 records in databases searching. After duplicates removal, we screened 9753 records, from which we reviewed 67 full-text documents, and finally included 7 papers (Adhikari et al., 2021; Bayram & Caliskan, 2019; Borg Sapiano et al., 2018; Chang et al., 2021; Cobbett & Snelgrove-Clarke, 2016; Kurt & Öztürk, 2021; Mager & Campbell, 2013) (Figure 1). Later, we searched documents that cited any of the initially included articles as well as the references of the initially included articles. However, no more studies that fulfilled eligibility criteria were found in these searches. The studies we found conducted in North America, Europe and Asia. In particular, two articles were from Turkey (Bayram & Caliskan, 2019; Kurt & Öztürk, 2021) and the remaining were each from USA (Mager & Campbell, 2013), Taiwan (Chang et al., 2021), Malta (Borg Sapiano et al., 2018), UK (Adhikari et al., 2021) and Canada (Cobbett & Snelgrove-Clarke, 2016). Of all, five studies (Bayram & Caliskan, 2019; Chang et al., 2021; Cobbett & Snelgrove-Clarke, 2016; Kurt & Öztürk, 2021; Mager & Campbell, 2013) were used experimental study design while the other two employed mixed (Adhikari et al., 2021) and pre-post designs (Borg Sapiano et al., 2018). Six studies (Bayram & Caliskan, 2019; Borg Sapiano et al., 2018; Chang et al., 2021; Cobbett & Snelgrove-Clarke, 2016; Kurt & Öztürk, 2021; Mager & Campbell, 2013) experimented a case scenario-based comparison between two groups of student nurses while the remaining (Adhikari et al., 2021) focused in a single group's pre-post knowledge and or/self-efficacy difference. The sources of study population were student nurses of baccalaureate and diploma levels. The sample size in the studies ranged from 19 to 166 that summed up a total of 619 student nurses (Table 2).

Table 2. Characteristics of studies included in the review.

Authors (Year)	Country	Aim	Study design	Sample size	Participants	Sampling technique	Intervention	Comparison	Outcome variables	Summary of findings
D.R. Mager et al. (2013)	USA	To test a home care simulation model of education and examine students' confidence and knowledge in managing medications and prefilling patient medication boxes in a home care setting	Qausi-experiemental	60	BSc student nurses	SRS	Medication administration	Classroom vs electronic MAR	Self-confidence and knowledge	Students' knowledge and skill levels in cardiac auscultation were found to be improved using high-fidelity simulators and standard training techniques. The high-fidelity simulator method, on the other hand, was found to be more effective than traditional teaching methods in increasing students' knowledge and skill levels; this increase was statistically significant. Additionally, high-fidelity simulator group showed a significant decrease in anxiety scores compared to the participants who were trained

										with traditional education method.
R. Adhikari et al. (2021)	UK	To investigate the impact of immersed virtual reality (IVR) sepsis game on pre-registration nurses' self-efficacy and, (2) explore their perceptions of the acceptability and applicability of IVR sepsis game as an adjunct to nursing simulation education.	Mixed	19	Pre-registration student nurses	Convenience	Sepsis	Pre-post sepsis game	Knowledge, self-confidence and anxiety	A significant increase was evidenced in perceived self-confidence score from pre to post simulation. Knowledge test results demonstrated a statistically significant difference between classroom and electronic medication administration simulation groups in home care.
Shelley Cobbett and Erna Snelgrov	Canada	To compare the effectiveness of two maternal newborn clinical	RCT	66	BSc student nurses	SRS	Preeclampsia and group B strep	Face-to-face vs Virtual clinical simulation	Knowledge, self-confidence	Pre-posttest scores revealed significant increase in self-confidence and decrease in

e-Clarke (2016)		simulation scenarios; virtual clinical simulation and face-to-face high fidelity manikin simulation							and anxiety	anxiety. The respondents found that the
A. Borg Sapiano et al. (2018)	Malta	To investigate the effectiveness of virtual simulation in improving student nurses' knowledge and performance during rapid patient deterioration.	Pre-post design	166	Diploma and BSc student nurses	NA	Cardiac-Shock-Respiratory	pre-post virtual simulation	Knowledge and skill	IVR sepsis simulation was realistic, immersive and interactive. Also, the majority students perceived that IVR had a positive impact on knowledge acquisition.
Y. Kurt and H. ¨Oztürk (2021)	Turkey	To evaluate the effect of Mobile Augmented Reality (MAR) educational materials on the knowledge and	RCT	122	BSc student nurses	NA	Injection	Mobile Augmented Reality (MAR) vs projection tool	Knowledge, self-confidence and skill	Between face-to-face and virtual clinical simulations, there were no statistically significant changes in student knowledge and self-confidence. Anxiety scores were higher for nurse

		skill levels of nursing students on injection practices								students in the virtual clinical simulation than for those within the face-to-face simulation. Students' preference was face-to-face citing the similarities to practicing in actual situation and the immediate debrief. Students who disliked the virtual clinical simulation frequently cited technology concerns as a reason for their dissatisfaction.
S.B. Bayram and N. Caliskan (2019)	Turkey	This study aims at determining the effect of a game-based virtual reality phone application on tracheostomy care education for nursing students.	RCT	86	BSc student nurses	SRS	Tracheostomy care	Mobile virtual game vs clinical	Knowledge and skill	Participants had a better level of satisfaction and self-confidence following the classroom video intervention than for prior high-fidelity simulations within the laboratory. Nurse students perceived that the simulation design was preferable for the classroom intervention than for the prior laboratory simulations.

Y.C. Chang et al. (2021)	Taiwan	The study's aim was to test the hypothesis that nursing students who used a mobile learning app would have significantly (1) higher levels of knowledge about medication administration and nasotracheal suctioning,	RCT	100	BSc student nurses	SRS	Nasotracheal suctioning and medication administration	Mobile app vs traditional teaching simulation	Knowledge, skill, and satisfaction	A significant improvement in the students' knowledge was observed after carrying out the web-based simulation intervention

2.3.2 Quality appraisal

The JBI quality assessment tools were adopted to evaluate the methodological quality of the articles, depend on the consensus of the two evaluators. The purpose of this appraisal is to assess the methodological quality of articles and to see the extent to which an article has addressed the possibility of bias in its analysis, conduct and design. Subsequently, we adopted three appraisal tools based on the appropriateness of the methodology being employed during the study in each article. Accordingly, we used checklist appraisal tools for quasi-experimental, randomized controlled trial and qualitative research ("JBI Manual for Evidence Synthesis," 2020; Moola et al., 2017; The Joanna Briggs Institute, 2017). Basically, studies with clear eligibility criteria for inclusion within the study, randomization process, detailed description of the context, reliable and valid measure of exposure, and adequate statistical analysis included in the review. Both authors agreed that articles with >50% score of the checklist elements to be categorized as high-quality papers.

As a result, 7 studies were of high methodological quality because all of these papers received a "Yes" rating for most relevant elements of the JBI Quality Assessment Tools (Adhikari et al., 2021; Bayram & Caliskan, 2019; Borg Sapiano et al., 2018; Chang et al., 2021; Cobbett & Snelgrove-Clarke, 2016; Kurt & Öztürk, 2021; Mager & Campbell, 2013). Eventually, no article was excluded for low methodological quality (Table 1).

2.3.3 Effectiveness of digital simulation on nurse students' knowledge acquisition

Seven articles demonstrated the effect of digital simulation on student nurses perceived knowledge acquisition (Adhikari et al., 2021; Bayram & Caliskan, 2019; Borg Sapiano et al., 2018; Chang et al., 2021; Cobbett & Snelgrove-Clarke, 2016; Kurt & Öztürk, 2021; Mager & Campbell, 2013). Three studies revealed that there was a significant knowledge difference between student nurses who used mobile application and those who did not in different clinical scenario. More importantly, students who participated in a mobile simulation demonstrated higher knowledge score than students who did not (Bayram & Caliskan, 2019; Chang et al., 2021; Kurt & Öztürk, 2021). In line with this, majority of nurse students who had played sepsis game witnessed that they had a positive impact on their knowledge acquisition status (Adhikari et al., 2021). In University of Malta, a significant improvement in the student nurses' post-scenario knowledge was recorded following their participation in a computer based virtual simulation program named FIRST2ACTWeb™ (Borg Sapiano et al., 2018). While, the study in

USA concluded that electronic method is better than the class-room based medication administration simulation in terms of knowledge acquisition (Mager & Campbell, 2013). In contrast, the finding in Canada revealed that there were no statistical differences in student knowledge between face-to-face and virtual clinical simulations (Cobbett & Snelgrove-Clarke, 2016).

2.3.4 Effectiveness of digital simulation on nurse students' self-confidence

Four studies focused on the effectiveness of digital simulation on student nurses' self-confidence (Adhikari et al., 2021; Cobbett & Snelgrove-Clarke, 2016; Kurt & Öztürk, 2021; Mager & Campbell, 2013). Three studies proved that a significant increase in perceived self-confidence score of student nurses' from pre to post electronic simulation (Adhikari et al., 2021; Kurt & Öztürk, 2021; Mager & Campbell, 2013). However, the study by Shelley Cobbett and Erna Snelgrove-Clarke did not show significant difference between the student's self-confidence in the face-to-face group and virtual clinical simulation group (Cobbett & Snelgrove-Clarke, 2016).

2.3.5 Effectiveness of digital simulation on nurse students' anxiety level

Regarding anxiety, two articles are found that links digital simulation and anxiety level among student nurses (Adhikari et al., 2021; Cobbett & Snelgrove-Clarke, 2016). According to Shelley Cobbett and Erna Snelgrove-Clarke reported that virtual clinical simulation was more effective than the face-to-face simulation in decreasing students' anxiety level (Cobbett & Snelgrove-Clarke, 2016). Likewise, a study in UK indicated that there was a significant decrease in anxiety level of nurse students from pre to post sepsis game simulation (Adhikari et al., 2021).

2.4 Discussion

Currently in the literature, there were a wide variety of digital technologies being used and investigated for their importance in the nursing education system. We set out to summarize the effectiveness of digital simulation on student nurses' knowledge, confidence, and anxiety in comparison to face-to-face simulation. We found nine articles that demonstrated the effect of digital simulation on nursing students learning. There were a greater number of quantitative studies which indicates good evidence that digital simulation was an effective tool for users to gain knowledge, boost confidence and decrease anxiety level in nursing education. The qualitative part highlighted that student's perception and engagement was high and encouraged the users to study nursing. The qualitative part contains subjective responses from nursing student users of the technology which was an important aspect to consider as it forecasts if

students will use the technology to study nursing. In addition, the positive response from qualitative articles may lead to the increase in the quantitative test scores of the users of the technology.

Accordingly, in this review, most of the articles confirmed that there is significant difference between digital simulation and face-to-face simulation on nursing students' knowledge, self-confidence, and anxiety level.

Studies conducted to evaluate the effectiveness of digital simulation on nursing students' knowledge found optimistic results. Overall, majority of the articles included in the review indicated that the digital simulation perceived to be effective in improving the nursing students' knowledge (Adhikari et al., 2021; Bayram & Caliskan, 2019; Borg Sapiano et al., 2018; Chang et al., 2021; Kurt & Öztürk, 2021; Mager & Campbell, 2013). Furthermore, a study by B. Vural Doğru et al proved that the high-fidelity simulator method was more effective than the traditional face-to-face teaching method with regard to knowledge acquisition (Vural Doğru & Zengin Aydın, 2020). Whereas the study by Shelley Cobbett and Erna Snelgrove-Clarke argues that virtual clinical simulations does not make differences on the students' knowledge acquisition in comparison to face-to-face simulation. Also, a pooled analysis of studies comparing the effect of virtual patients to traditional education showed similar results for knowledge between virtual and traditional education in health professions education (Kononowicz et al., 2019). Hence, the inconsistency between studies might be originated from the trials comparing digital simulation with different forms of traditional education packages and design variants.

With regard to self-confidence, three out of five articles which are included in the review showed that the digital simulation has a positive impact in boosting the self-confidence of student nurses (Adhikari et al., 2021; Kurt & Öztürk, 2021; Mager & Campbell, 2013). Also, a complementary finding reported that a better confidence was perceived among pathology students who undertook virtual simulation (Quail et al., 2016). On the other side, however, the study by Shelley Cobbett and Erna Snelgrove-Clarke concluded that there is no significant differences in student's self-confidence between face-to-face and virtual clinical simulations (Cobbett & Snelgrove-Clarke, 2016). This controversy might be resulted from the possible differences in case scenario, involved technology, and other environmental factors.

In the present review, two studies (Adhikari et al., 2021; Cobbett & Snelgrove-Clarke, 2016) showed that the digital simulation tends to be effective in decreasing anxiety level of

nursing students in comparison to face-to-face clinical simulation while the opposite is true in third study (Vural Doğru & Zengin Aydın, 2020). In fact, mild anxiety is inevitable during first exposure to clinical simulations and practices. In a previous study, anxiety was reported frequently among nursing students undertaking computer-based simulation. Students noted feelings of being overwhelmed by the amount of information to know and did not feel the lab simulation was a learning process (Donovan et al., 2018).

2.4.1 Limitations

In the literature, there was a limited number of studies evaluating the relative effectiveness between digital simulation and face-to-face simulation.

2.5 Conclusion

Overall, available literature are encouraging the harmonization of digital simulation with face-to-face simulation in the nursing education system. Our finding encourages utilization of digital simulation can improve the student nurses' knowledge acquisition, boost self-confidence and decrease anxiety level.

Chapter 3 – Research methodology

3.1 Study setting

The study was conducted in Edinburgh Napier University, Scotland, United Kingdom. Edinburgh is the capital city and second-most populous city of Scotland. In 2016, the official population estimates were 512,150 (2016) for the Edinburgh settlement and 518,500 (2018) for the local authority area (*Edinburgh - Wikipedia*, n.d.). Edinburgh Napier university is one of the prestigious Scottish higher educational institutions across various disciplines. In particular, our study conducted in the School of Health and Social Care, Sighthill campus. In Scotland, the annual intakes of students in largest nursing schools lies between 550 and 650.

3.2 Study design and study period

A randomized controlled trial was employed among pre-registered nursing students from September 2021 to November 2021 at the school of health and social care, Sighthill campus, Edinburgh Napier University. Students were randomly assigned to use either the computer-based COVID-19 gaming simulation (experimental group) or manikin-based face-to-face COVID-19 simulation (control group). Confidence of participants was measured twice, before (pretest) and after (posttest) undertaking the simulations. Knowledge of participants about the digital and on campus simulation was measured during the experiment.

3.3 Recruitment of participants

All eligible participants were contacted via their Bachelor of Nursing programme moodle platform. This took place from 1 September, 2021 to 15 October, 2021. By then, students were informed more fully of the study and reassured that this study was not linked to their academic work, their participation was voluntary and, if they had a wish, they were free to withdraw consent at any point during the study. Also, potential participants were given their consent to consider their involvement in the study and contacted the main researcher to note interest. Once they have agreed to take part, a link to the online consent form and COVID-19 patient management workbook was forwarded to read before they enrolled in the study.

3.4 Sample size and sampling technique

In the quantitative part, we have used STATA version 11 to estimate sample size based on assumptions of alpha of 0.05 and 80% power. A two-tailed independent *t* -tests was run on to estimate the sample size to compare knowledge acquisition and cost analysis between students undertaking digital simulation to those undertaking on campus simulation. And a paired *t* -tests

was run to compare pretest and posttest confidence of participants. The final sample size appeared to be 74 students (Table 3). Therefore, we randomly assigned to the experimental group (computer -based gaming simulation) and the control group (manikin based face-to-face simulation), resulting in 37 students in each group.

Table 3. Sample size estimation

Method	Variable	Mean 1, SD (experimental group)	Mean 2, SD (control)	Sample(n1+n2(1:1)), after adding 10% for non-response rate
A two-tailed independent t t -tests	Knowledge(Chang et al., 2021)	80.9, 9.12	74.4, 9.61	66, **72**
		Mean 1, SD (pretest)	Mean 2, SD (posttest)	N after adding 10% for non-response rate
A two-tailed paired t -tests	Confidence(Adhikari et al., 2021)	86.9, 19.2	109.6,22.3	28, **30**
	Anxiety (Adhikari et al., 2021)	77.4, 12.5	59.3, 15.9	20, **22**
	Self-efficacy among experimental group(Kim & Suh, 2018)	125.5, 20.25	149.47, 16.52	20, **22**
	Self -efficacy among control group(Kim & Suh, 2018)	131.75, 22.98	144.94, 14.59	68, **74**

3.5 Eligibility criteria

3.5.1 Inclusion criteria

- All second- and third-year nursing students in the School of Health and Social Care, Sighthill campus, Edinburgh Napier University

3.5.2 Exclusion criteria

- 1st year nursing students

3.6 Variables

3.6.1 Dependent variables

- Knowledge acquisition
- Confidence

3.6.2 Independent variables

- Year of study
- Digital simulation
- Clinical simulation
- Age
- sex

3.7 Intervention

The computer-based digital simulation is an evidence-based, online guide for nursing students to acquire confidence and knowledge. In our study, a COVID-19 scenario game (experimental) was designed to be compatible with any computer and launched from a link to begin. Students were given an evidence based educational workbook in preparation for the scenario. Also, prior to the study, a short orientation was given to both the control and experimental groups by the researchers. The COVID-19 case scenario content was derived from medical references. The content is a sequential clinical decision-making process that participants had to follow when diagnosing and managing deteriorating COVID-19 patient. The game was developed in the way that participants can interact with audio, visual and stimuli. Technological concerns and challenges were mitigated by a support technical team throughout the process. The game allows the participant to respond or skip for each question in the scenario. The game had list of nursing interventions, patient history, notes and vital signs that students can use contextually. In the control group (on campus), students were presented with paper materials and high-fidelity simulation to manage the COVID-19 case scenario in the nursing laboratory. The contents and COVID-19 case scenario in the papers were matched with that of the computer-based simulation

contents. In addition, the students in the control group were accompanied with a supervisor who can help in performing the simulation. During the study, students were using the equipment and devices to manage the given clinical scenario. In both groups, we used the same knowledge and self-efficacy assessment tools(White, 2014).

3.8 Variable measurements

- Knowledge: Mean score was used to evaluate the knowledge acquisition of students in both the experimental and control groups
- Confidence: Pre-and-post mean score was used to evaluate the confidence of students in both the experimental and control groups
- Anxiety: Pre-and-post mean score was used to evaluate the anxiety level of students in both the experimental and control groups

3.9 Data collection

Data collection procedure was accompanied by two nurses and supervised by one professor. A structured and validated tools were used for both knowledge and self-efficacy assessment. In the knowledge part, the students made treatment and care decisions relating to immediate care and management of deteriorating COVID-19 case scenario. Also, the game includes interpretation of investigations, definitive treatment options, ongoing managements and referral. Based on the instruction, students were objectively responded their best answers. The knowledge questionnaire included 22 items with a possible maximum score of 25. Filled questionnaires were checked daily for completeness and consistency of the responses to eliminate possible errors. A validated and reliable (Cronbach's α=0.85) self-reported self-efficacy assessment tool was administered before and after both simulations (NASC-CDM), (White, 2014). To assess the self-confidence and anxiety level of student nurses. This tool had 27 items with two sub-scales (self-confidence and anxiety) to be responded using 6-point Likert scale. Accordingly, the participants rated their self-confidence and anxiety level from "1 (Not at all)" to "6 (Totally)" in the blank spaces provided in each item of the Nursing Anxiety and Self-Confidence with Clinical Decision Making (NASC-CDM©) tool. Each participant was taken an average of 40 minutes to complete the survey and simulation in both the experimental and control groups (Figure 2).

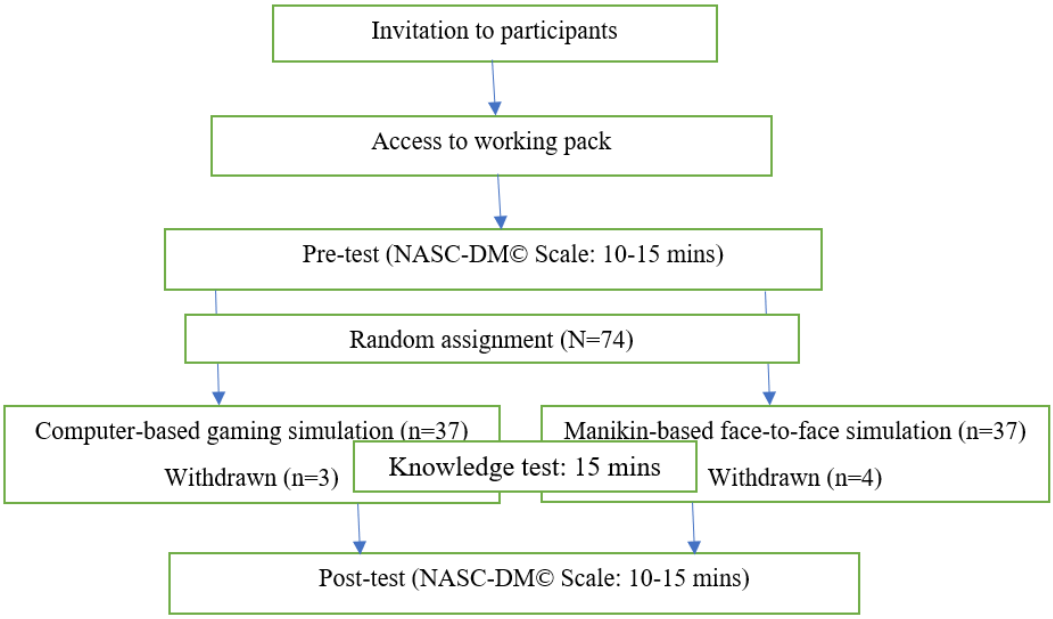

Figure 2. Data collection procedure

3.10 Data processing, analysis, and presentation

Data entered and analyzed using SPSS version 26. After data exploration and cleaning a univariate analysis has been done using frequency, percent, mean and standard deviation. An independent-samples T test and a paired-samples T test performed to detect differences between groups and within a group, respectively, at $p < 0.05$ and 95% CI. Eventually, result presented in text and tables.

3.11 Ethical consideration

Ethical clearance and approval obtained from the Research Ethics and Integrity Committee of the School of Health and Social Care, Edinburgh Napier University. Then, letter of cooperation given to conduct the study. Prior to data collection the objective of the study was explained to respondents and informed consent obtained from them to participate in the study. Consent was recorded using a standard consent which was completed and signed in paper format prior to enrolment in the survey. Confidentiality of the study participants has been kept in each level of the response.

3.12 Dissemination plan

The result of the study will be submitted and presented to the joint master's degree in ECCN hosting universities and other stakeholders. The research data will be deposited into a university repository, where they can be cited using a persistent identifier and will remain accessible for a minimum of ten years. Moreover, the findings of the study will be published and disseminated through reputable journal and scientific publications.

Chapter 4 - Research findings

4.1 Characteristics of study participants

Seventy-four students were enrolled in the study. We excluded seven students (four from the control group and three from the simulation group) because they could not complete all phases of the study, making overall response rate of 90.5%.

Eventually, a total of 67 full-time student nurses from both the second and third year of a degree course were fully eligible for further evaluation (n=33 in the control group and n=34 in the experimental group). Most of the participants in both the experimental and control groups were females, 31 (91.1) and 28 (84.9%), respectively. The students' ages were ranged between 18 and 55 years (Mean= 31.3, SD= 9.4). There were no significant age differences between the control and study groups ((MD= -1.86, 95% CI (-6.4, 2.7)) (Table 4).

Table 4. Characteristics of study participants

Variable	**Computer based gaming simulation (experimental) N (%) = 34**	**Manikin based face-to-face simulation (control) N (%) = 33**	**X^2 P-value**
Gender			0.29
Male	2 (5.9)	5 (15.1)	
Female	31 (91.1)	28 (84.9)	
other	1 (3)		
Year of study			0.54
2nd year	11 (32.4)	13 (39.4)	
3rd year	23 (67.6)	20 (60.6)	
Age			0.54
≤30 year	19 (55.9)	16 (48.5)	
>30 year	15 (44.1)	17 (51.5)	

4.2 Knowledge

The results of the students' independent t tests showed the existence of statistically significant differences in knowledge related to COVID-19 care between the experimental group and the

control group. The maximum possible knowledge score was 24 points. The mean knowledge score for the participants in the control group was higher than the intervention group, 21.4 ± 1.6 and 19.8± 2.1, respectively (Table 5). In both groups: sex, age, and year of study of the students showed no statistical differences in knowledge score.

Table 5. Independent-Samples T Test on the level of COVID-19 patient management knowledge between experimental and control groups

Variable	**Control**	**Experimental**	**MD**	**CI**	**P-value**
Knowledge	**M (SD)**	**M (SD)**			
Sex					
Male		22.5 (0.7)	2.8	(-0.3, 6.0)	0.08
Female		19.6 (2.1)			
Age					
≤ 30 years		19.5 (2.3)	-0.8	(-2.3, 0.7)	0.29
>30 years		20.3 (1.9)			
Year of study					
2nd year		19.1 (2.7)	-1.0	(-2.6, 0.5)	0.20
3rd year		20.2 (1.8)			
Sex					
Male	21.2 (1.3)		-0.3	(-1.9, 1.3)	0.71
Female	21.5 (1.7)				
Age					
*≤ 30 years	21.5 (1.4)		0.1	(-1.0, 1.2)	0.8
>30 years	21.4 (1.8)				
Year of study					
2nd year	21.8 (1.4)		0.6	(-0.5, 1.8)	0.27
3rd year	21.2 (1.7)				
Overall mean knowledge	21.4 (1.6)	19.8 (2.1)	-1.6	(-2.5, -0.6)	0.02

Level of significance=P<0.05, M=mean, MD=mean difference, SD= standard deviation, CI=confidence interval

4.3 Self-efficacy

The self-efficacy assessment tool was administered before and after simulation in both groups (NASC-CDM), (White, 2014) to assess the self-confidence and anxiety level of student nurses in managing a patient deteriorating of COVID-19 infection. Both confidence and anxiety level were rated using 6-point Likert scale, with a possible mean score range between 1 and 6.

4.3.1 Self-confidence

The mean self-confidence score before the test (pretest) in the experimental group and control group was 3.6 ± 0.7 and 3.4 ± 0.8, respectively. After the test (posttest), the mean self-confidence score in the experimental group and control group became 3.8 ± 1.1 and 4.3 ± 0.9, respectively. An independent t test indicated no statistically significant differences between the experimental group and the control group in both before the test and after the test for self-confidence of the students in managing COVID-19 patient, ((MD= 0.17, 95% CI (-0.2, 0.5)) and ((MD= -0.42, 95% CI (-0.9, 0.1)), respectively.

Also, a paired sample t test indicated no statistically significant differences before the test and after the test in the experimental group for self-confidence of the students in managing COVID-19 patient, (MD=-0.28, 95% CI (-0.6-0.0)). However, a significant statistical difference for confidence was observed between pretest and posttest in the control group, (MD=-0.88, 95% CI (-1.1, -0.6)). The initial mean confidence score in the control group was 3.4±0.8, which increased to 4.3± 0.9 at posttest (Table 6).

4.3.2 Anxiety

Before starting the simulation, the experimental and control students' mean anxiety score was 2.6±0.5 and 2.6 ±0.6, respectively. On independent-samples t test, there was no observable statistical differences in mean anxiety score between the two groups, (MD=0.01, 95% CI (-0.2, 0.3). After simulation, a significant statistical difference was found in the mean anxiety scores between the experimental and control groups, (MD=0.52, 95% CI (0.1, 0.8)). Implies, the mean anxiety score in the experimental group (2.5±0.8) was higher than the control group (2.0±0.5). Furtherly, we run a paired-samples t test to see if there would be differences before and after simulation anxiety tests in each group. Accordingly, there were no statistically significant mean differences from pretest to posttest in the experimental group, MD=0.09, 95% CI (-0.1,0.2). In

contrast, the anxiety level of the students in the control group decreased from pretest (2.6 ± 0.6) to post (2.0 ± 0.5), MD=0.55, 95% CI (0.3, 0.7) (Table 6).

Table 6. A Paired-Samples T Test on the level self-efficacy of student nurses before and after test.

Variable	**Pretest**	**Posttest**	**MD**	**CI**	**P-value**
Self-confidence	**M (SD)**	**M (SD)**			
Experimental	3.6 (0.7)	3.8 (1.1)	-0.28	(-0.6-0.0)	0.08
Control	3.4 (0.8)	4.3 (0.9)	-0.88	(-1.1, -0.6)	<0.01
Anxiety					
Experimental	2.6 (0.5)	2.5 (0.8)	0.03	(-0.1, 0.2)	0.69
Control	2.6 (0.6)	2.0 (0.5)	0.55	(0.3, 0.7)	<0.01

P<0.05, M=mean, MD=mean difference, SD=standard deviation, CI=confidence interval

Chapter 5 – Discussion and analysis of findings

We hypothesized that there would be significant difference in knowledge acquisition between nurse students who performed a computer-based gaming simulation and a traditional way of manikin-based face-to-face simulation; in management of a deteriorating COVID-19 case scenario. Our randomized controlled study demonstrated that the control group, who underwent the manikin-based face-to-face simulation, had superior knowledge in assessing and managing a patient deteriorating of COVID-19 Pneumonia, compared to the experimental group who undertook the computer-based gaming simulation. Nevertheless, a previous study conducted among undergraduate nursing students in Canada showed that there were no differences in students' knowledge between manikin-based face-to-face simulation and the virtual clinical simulation in management of maternal newborn case scenario (Cobbett & Snelgrove-Clarke, 2016). Our finding is also opposite to other related experiments from Northeastern United States and Taiwan that conducted on Baccalaureate nursing students. According to these studies, the knowledge score for medication administration was higher among students who undertook mobile simulation than those of demonstrated with interactive face -to-face simulation (Chang et al., 2021; Mager & Campbell, 2013). The face-to-face simulation might be preferred over gaming simulation in students' knowledge acquisition as it allows interactive learning between the mentor and the student undertaking the demonstration. Despite this, the mean knowledge score of the students among the computer-based gaming simulation group was 19.8/24 (82.5%). This showed that the gaming simulation could still be an effective teaching approach to equip and prepare students in knowledge for clinical practice especially in time of scarce resources. Furthermore, virtual simulation can be utilized as an effective substitute in place of traditional face-to-face clinical in situations where there is a lack of appropriate clinical placement opportunities such as during COVID-19 pandemic (Fogg et al., 2020).

Furtherly, we hypothesized there would be significant differences in the self-efficacy of student nurses before and after undertaking both simulations. A NASC-CDM© tool was adopted to evaluate the self-efficacy of student nurses with its two subscale, self-confidence and anxiety. A significant improvement of students' self-confidence was observed from pretest to post-test in the manikin-based face-to-face simulation group. The initial mean confidence score in the group was 3.4±0.8, which increased to 4.3± 0.9 at posttest. This finding is consistent with the study conducted by C. Chung et al in Australia where nurse staff showed significant improvement of

self-confidence after taking face-to-face simulation training (Chung et al., 2018). This might be due to the fact that students are fully supported and under instruction of their mentors. It also allows students to ask their mentors in time of need for clarification and other supports (Liaw et al., 2012). In contrast, these opportunities were limited to technical support among the gaming simulation group. Of course, during the game, the avatars do give prompts, but this might not be as responsive as prompts and support provided by the clinical simulation facilitator. Consequently, as proven by our investigation, the self-confidence of students did not show significant statistical differences from pretest to posttest in the computer-based gaming simulation group. That said, the self- confidence score of students at posttest was higher than the pretest. This demonstrates that computer-based gaming simulation is better than no simulation at all.

In the present study, at post-simulation, the mean anxiety score in the computer-based gaming was significantly higher than the manikin-based face-to-face group. Likewise, studies in Turkey and Canada proved that the face-to-face simulation tends to be effective in decreasing anxiety level of nursing students in comparison to digital simulation (Cobbett & Snelgrove-Clarke, 2016; Vural Doğru & Zengin Aydın, 2020). In fact, mild anxiety is inevitable during first exposure to simulations and practices, but it might be worse in digital simulation due to the limited technical and computer skills of students (Cobbett & Snelgrove-Clarke, 2016). On top of this, the signals and reactions of the gaming simulation, for wrong answers, could trigger anxiety in the students.

Our study also found that the anxiety level of the students in the manikin-based face-to-face group decreased from pretest to post. This finding aligns with a mixed study in Saudi Arabia which investigated the physiological and psychological anxiety progress of nurse students during performing emergency simulation scenarios. According to this study, the physiological anxiety of student nurses was high at the start of the simulation but decreased towards the end as the students gained familiarly with the face-to-face clinical simulation environment (Al-Ghareeb et al., 2019).

On the other hand, although a study in the same setting revealed that the students' anxiety was lowered after gaming simulation (Adhikari et al., 2021), we did not find out the same trend in our experiment. The present experiment confirmed that whilst there was a reduction in anxiety, there were no significant differences of anxiety mean scores between pre and post

intervention tests in the computer-based gaming simulation group. This implies, computer-based gaming simulation could be an adjunct to learning in situations where in-person simulation is ineffective such as in the absence of simulation facilities, fully online learning or during a global pandemic.

Overall, we stressed that the manikin-based face-to-face simulation is superior to computer-based gaming simulation in terms of students' knowledge acquisition, boosting self-confidence and minimizing anxiety. The advantage of virtual simulation over the face-to-face simulation is that the students can use their own personal laptop and be supervised by a single supervisor at the same time. However, the virtual simulation cannot fully replace face-to-face simulation because it is not as holistic as human in terms of the feelings and overall companionship that a supervisor can do. Hence, these findings contribute to the existing and emerging literature that suggests nursing students achieve higher learning outcomes through integration of gaming with face-to-face simulations in nursing education (Besse et al., 2020).

5.1 Strength

Above all, the experimental nature of our study increases precision of findings and strength of correlation between variables. As far as we know, this is the first experimental study conducted in United Kingdom to assess student nurses' self-efficacy and knowledge acquisition during the pandemic COVID-19. Furthermore, the randomization process of recruiting students had a positive impact on minimizing randomization bias and increasing representativeness of the findings. Also, we adopted standardized data collection instruments with proved validity and reliability (White, 2014). Despite the pandemic and students' time constraint, we have reached the target sample size required in our study, with 90.5% response rate. Students were undertaking the experiment and tests at the same place and time. This minimizes the possibility of research data, such as content of the questionnaire, disclosure between students. Plus, it does not allow students to continue the experiment in parts at different points of time. Subsequently, all possibilities of data contamination and recall bias were kept to the possible minimum level. We had only one data collector in one group throughout the data collection period. This has decreased the tendency of inter-rater reliability bias and subsequently has addressed the need for grading consistency (Mager & Campbell, 2013). Lastly, all COVID-19 prevention measures were secured to minimize the risk of COVID-19 infection in students and subsequent effect on the study. Also, the implications of our findings could reflect the effective applicability of digital

simulation in countries without satisfactory simulation environments. Implies, in countries where there are no substantial simulation resources, student nurses still can use computer-gaming simulation to improve their self-efficacy and clinical knowledge.

5.2 Weakness

This randomized control trial study was not free of limitations. Firstly, the data collection procedure was time consuming that might be contributed to the withdrawal of some participants from the study. Another, the recruitment of students was challenging due to large pool of potential participants, class and hospital placement schedules. Also, hesitancy among students has been observed because of COVID-19 risks. Moreover, our study could have measured three arms, study control and perhaps students taking a test without any simulation. This implies, in addition to the two arms, computer-based gaming simulation and manikin-based face-to-face simulation, we could have considered a third arm who do not belong to either of these groups but only to lecture.

Chapter 6 - Conclusion and recommendations

The present study adds evidence to the existing base of knowledge on the effectiveness of digital simulation in learning outcomes in comparison to face-to-face simulation. Overall, computer-based gaming simulation was not as effective as the manikin-based face-to-face simulation in improving student nurses' self-efficacy and knowledge acquisition. Our experiment demonstrated that the manikin-based face-to-face simulation was superior to the computer-based gaming simulation in nurse students' knowledge acquisition. Furtherly, significant improvements of students' self-confidence and anxiety was observed from pretest to post-test in the manikin-based face-to-face simulation group. Also, the present experiment confirmed that whilst there were improvements in self-confidence and anxiety, there were no significant statistical differences between pre and post intervention tests in the computer-based gaming simulation group. These findings suggest that any simulation activity supports learning and increases students' confidence and reduces anxiety which may improve clinical performance. Therefore, computer-based gaming could be an adjunct simulation in situations where in-person simulation is not possible.

References

Adhikari, R., Kydonaki, C., Lawrie, J., O'Reilly, M., Ballantyne, B., Whitehorn, J., & Paterson, R. (2021). A mixed-methods feasibility study to assess the acceptability and applicability of immersive virtual reality sepsis game as an adjunct to nursing education. *Nurse Education Today*, *103*(April), 104944. https://doi.org/10.1016/j.nedt.2021.104944

Al-Ghareeb, A., McKenna, L., & Cooper, S. (2019). The influence of anxiety on student nurse performance in a simulated clinical setting: A mixed methods design. *International Journal of Nursing Studies*, *98*, 57–66. https://doi.org/10.1016/J.IJNURSTU.2019.06.006

Bayram, S. B., & Caliskan, N. (2019). Effect of a game-based virtual reality phone application on tracheostomy care education for nursing students: A randomized controlled trial. *Nurse Education Today*, *79*, 25–31. https://doi.org/10.1016/j.nedt.2019.05.010

Besse, C., Vogelsang, L., & Zdunich, J. (2020). The simulation games: Bringin' it to the bedside. *Nurse Educator*, *45*(6), 339–342. https://doi.org/10.1097/NNE.0000000000000832

Borg Sapiano, A., Sammut, R., & Trapani, J. (2018). The effectiveness of virtual simulation in improving student nurses' knowledge and performance during patient deterioration: A pre and post test design. *Nurse Education Today*, *62*, 128–133. https://doi.org/10.1016/j.nedt.2017.12.025

Chang, H. Y., Wu, H. F., Chang, Y. C., Tseng, Y. S., & Wang, Y. C. (2021). The effects of a virtual simulation-based, mobile technology application on nursing students' learning achievement and cognitive load: Randomized controlled trial. *International Journal of Nursing Studies*, *120*, 103948. https://doi.org/10.1016/j.ijnurstu.2021.103948

Choi, H., Lee, U., Jeon, Y. S., & Kim, C. (2020). Efficacy of the computer simulation-based, interactive communication education program for nursing students. *Nurse Education Today*, *91*(February), 104467. https://doi.org/10.1016/j.nedt.2020.104467

Chung, C., Cooper, S. J., Cant, R. P., Connell, C., McKay, A., Kinsman, L., Gazula, S., Boyle, J., Cameron, A., Cash, P., Evans, L., Kim, J. A., Masud, R., McInnes, D., Norman, L., Penz, E., Rotter, T., Tanti, E., & Breakspear, T. (2018). The educational impact of web-based and

face-to-face patient deterioration simulation programs: An interventional trial. *Nurse Education Today*, *64*, 93–98. https://doi.org/10.1016/j.nedt.2018.01.037

Cobbett, S., & Snelgrove-Clarke, E. (2016). Virtual versus face-to-face clinical simulation in relation to student knowledge, anxiety, and self-confidence in maternal-newborn nursing: A randomized controlled trial. *Nurse Education Today*, *45*, 179–184. https://doi.org/10.1016/j.nedt.2016.08.004

Connolly, Thomas and Stansfield, M. (2007). Games-Based E-Learning: Implications and Challenges for Higher Education and Training. *Social Implications and Challenges of E-Business*, 42.

Donovan, L. M., Argenbright, C. A., Mullen, L. K., & Humbert, J. L. (2018). Computer-based simulation: Effective tool or hindrance for undergraduate nursing students? *Nurse Education Today*, *69*, 122–127. https://doi.org/10.1016/J.NEDT.2018.07.007

Edinburgh - Wikipedia. (n.d.). Retrieved August 1, 2021, from https://en.wikipedia.org/wiki/Edinburgh

Fogg, N., Wilson, C., Trinka, M., Campbell, R., Thomson, A., Merritt, L., Tietze, M., & Prior, M. (2020). Transitioning from direct care to virtual clinical experiences during the COVID-19 pandemic. *Journal of Professional Nursing*, *36*(6), 685–691. https://doi.org/10.1016/J.PROFNURS.2020.09.012

JBI Manual for Evidence Synthesis. (2020). *JBI Manual for Evidence Synthesis*. https://doi.org/10.46658/JBIMES-20-01

Jin, Yuefei and Yang, Haiyan and Ji, Wangquan and Wu, Weidong and Chen, Shuaiyin and Zhang, Weiguo and Duan, G. (2020). Intuition on virology, epidemiology, pathogenesis, and control of COVID-19. *Novel Research in Microbiology Journal*, *4*(5), 955–967. https://doi.org/10.21608/nrmj.2020.118446

Johnsen, H. M., Fossum, M., Vivekananda-Schmidt, P., Fruhling, A., & Slettebø, Å. (2018). Developing a serious game for nurse education. *Journal of Gerontological Nursing*, *44*(1), 15–19. https://doi.org/10.3928/00989134-20171213-05

Kim, H., & Suh, E. E. (2018). The Effects of an Interactive Nursing Skills Mobile Application on Nursing Students' Knowledge, Self-efficacy, and Skills Performance: A Randomized Controlled Trial. *Asian Nursing Research*, *12*(1), 17–25. https://doi.org/10.1016/j.anr.2018.01.001

Koivisto, J. M., Multisilta, J., Niemi, H., Katajisto, J., & Eriksson, E. (2016). Learning by playing: A cross-sectional descriptive study of nursing students' experiences of learning clinical reasoning. *Nurse Education Today*, *45*, 22–28. https://doi.org/10.1016/j.nedt.2016.06.009

Kononowicz, A. A., Woodham, L. A., Edelbring, S., Stathakarou, N., Davies, D., Saxena, N., Car, L. T., Carlstedt-Duke, J., Car, J., & Zary, N. (2019). Virtual patient simulations in health professions education: Systematic review and meta-analysis by the digital health education collaboration. *Journal of Medical Internet Research*, *21*(7), 1–20. https://doi.org/10.2196/14676

Kurt, Y., & Öztürk, H. (2021). The effect of mobile augmented reality application developed for injections on the knowledge and skill levels of nursing students: An experimental controlled study. *Nurse Education Today*, *103*, 104955. https://doi.org/10.1016/j.nedt.2021.104955

Lavoie, P., Michaud, C., Bélisle, M., Boyer, L., Gosselin, É., Grondin, M., Larue, C., Lavoie, S., & Pepin, J. (2018). Learning theories and tools for the assessment of core nursing competencies in simulation: A theoretical review. *Journal of Advanced Nursing*, *74*(2), 239–250. https://doi.org/10.1111/JAN.13416

Liaw, S. Y., Scherpbier, A., Rethans, J.-J., & Klainin-Yobas, P. (2012). Assessment for simulation learning outcomes: a comparison of knowledge and self-reported confidence with observed clinical performance. *Nurse Education Today*, *32*(6), e35-9. https://doi.org/10.1016/j.nedt.2011.10.006

Mager, D. R., & Campbell, S. H. (2013). Home care simulation for student nurses: medication management in the home. *Nurse Education Today*, *33*(11), 1416–1421. https://doi.org/10.1016/j.nedt.2012.11.007

Martí-Parreño, J., Méndez-Ibáñez, E., & Alonso-Arroyo, A. (2016). The use of gamification in education: a bibliometric and text mining analysis. *Journal of Computer Assisted Learning*, *32*(6), 663–676. https://doi.org/10.1111/jcal.12161

Moher, David and Liberati, Alessandro and Tetzlaff, Jennifer and Altman, D. G. and P. G. and others. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Medicine*, *6*(7), e1000097.

Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetcu, R., Currie, M., Qureshi, R., Mattis, P., Lisy, K., & Mu, P.-F. (2017). *Checklist for RCTs*.

Murray, C., Grant, M. J., Howarth, M. L., & Leigh, J. (2008). The use of simulation as a teaching and learning approach to support practice learning. *Nurse Education in Practice*, *8*(1), 5–8. https://doi.org/10.1016/j.nepr.2007.08.001

Peisachovich, E., Da Silva, C., Penhearow, N. J., Sombilon, E. V, & Koh, M. (2020). Implementing Virtual Simulated Person Methodology to Support the Shift to Online Learning: Technical Report. *Cureus*, *12*(6). https://doi.org/10.7759/cureus.8864

Peters, T., & Thrien, C. (2020). The digital use of simulated patients in times of the corona pandemic-considerations and proposals. *GMS Journal for Medical Education*, *37*(7). https://doi.org/10.1080/01421590903002821

Pront, L., Müller, A., Koschade, A., & Hutton, A. (2018). Gaming in Nursing Education: A Literature Review. *Nursing Education Perspectives*, *39*(1), 23–28. https://doi.org/10.1097/01.NEP.0000000000000251

Quail, M., Brundage, S. B., Spitalnick, J., Allen, P. J., & Beilby, J. (2016). *Student self-reported communication skills, knowledge and confidence across standardised patient, virtual and traditional clinical learning environments*. https://doi.org/10.1186/s12909-016-0577-5

Rourke, S. (2020). How does virtual reality simulation compare to simulated practice in the acquisition of clinical psychomotor skills for pre-registration student nurses? A systematic review. *International Journal of Nursing Studies*, *102*, 103466. https://doi.org/10.1016/J.IJNURSTU.2019.103466

The Joanna Briggs Institute. (2017). Checklist for Qualitative Research. In *The Joanna Briggs Institute*.

Tsang, H. F., Chan, L. W. C., Cho, W. C. S., Yu, A. C. S., Yim, A. K. Y., Chan, A. K. C., Ng, L. P. W., Wong, Y. K. E., Pei, X. M., Li, M. J. W., & Wong, S. C. C. (2021). An update on COVID-19 pandemic: the epidemiology, pathogenesis, prevention and treatment strategies. *Expert Review of Anti-Infective Therapy*, *19*(7), 877–888. https://doi.org/10.1080/14787210.2021.1863146

Verkuyl, M., Lapum, J. L., St-Amant, O., Hughes, M., & Romaniuk, D. (2021). Development and Innovation Curricular uptake of virtual gaming simulation in nursing education. *Nurse Education in Practice*, *50*. https://doi.org/10.1016/j.nepr.2021.102967

Vural Doğru, B., & Zengin Aydın, L. (2020). The effects of training with simulation on knowledge, skill and anxiety levels of the nursing students in terms of cardiac auscultation: A randomized controlled study. *Nurse Education Today*, *84*, 104216. https://doi.org/10.1016/j.nedt.2019.104216

White, K. A. (2014). Development and validation of a tool to measure self-confidence and anxiety in nursing students during clinical decision making. *Journal of Nursing Education*, *53*(1), 14–22. https://doi.org/10.3928/01484834-20131118-05

Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing*, *52*(5), 546–553. https://doi.org/10.1111/J.1365-2648.2005.03621.X

Appendices

Appendix I. Literature searching terms and results

Source	Searching terms/query	Search ID	Filter	result
PubMed	((((simulation[MeSH Terms]) OR (simulation[Text Word])) AND ((nurs*[Text Word]) OR (nurs*[MeSH Terms]))) AND ((student*[Text Word]) OR (student*[MeSH Terms]))) AND (((knowledge[Text Word]) OR (knowledge[MeSH Terms])) OR ((confidence[Text Word]) OR (confidence[MeSH Terms]))))		As of 18:00, 04/10/2021; Full article, English, 2011-2022	1097
HINARI	((((simulation[MeSH Terms]) OR (simulation[Text Word])) AND ((nurs*[Text Word]) OR (nurs*[MeSH Terms]))) AND ((student*[Text Word]) OR (student*[MeSH Terms]))) AND (((knowledge[Text Word]) OR (knowledge[MeSH Terms])) OR ((confidence[Text Word]) OR (confidence[MeSH Terms]))))		As of 18:00, 04/10/2021; Full article, English, 2011-2022	13023
CINAHL	simulation AND nurse AND students	#1		520
	knowledge OR confidence	#2		54133
		#1 AND #2		161
Other sources				86
Total				14367
Final in review				7

Appendix II. JBI critical appraisal checklist for randomized controlled trials

Criteria	S. Cobbett, E. et al. (2016)	Y. Kurt and H. ¨Oztürk (2021)	S.B. Bayram and N. Caliskan (2019)	Y.C. Chang et al. (2021)
Was true randomization to treatment groups?	√	√	√	√
Was allocation to treatment groups concealed?	√	√	√	√
Were treatment groups similar at the baseline?	√	√	√	√
Were participants blind to treatment assignment?	√	√	√	√
Were those delivering treatment blind to treatment assignment?	√	√	√	√
Were outcomes assessors blind to treatment assignment?	√	√	√	√
Were treatment groups treated identically other than the intervention of interest?	√	√	√	√
Was follow up complete and if not, were differences described and analyzed?	√	√	√	√

Were participants analyzed in the groups to which they were randomized?	√	√	√	√
Were outcomes measured in the same way for treatment groups?	√	√	√	√
Were outcomes measured in a reliable way?	√	√	√	√
Was appropriate statistical analysis used?	√	√	√	√
Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	√	√	√	√
Total score (13)	13	13	13	13

Appendix III. JBI Critical Appraisal Checklist for quasi-experimental studies

Criteria	D.R. Mager et al. (2013)
Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	√
Were the participants included in any comparisons similar?	√
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	√
Was there a control group?	√
Were there multiple measurements of the outcome both pre and post the intervention/exposure?	√
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	√
Were the outcomes of participants included in any comparisons measured in the same way?	√
Were outcomes measured in a reliable way?	√
Was appropriate statistical analysis used?	√
Total	9

Appendix IV. Mixed methods appraisal tool (MMAT) version 2018

Criteria	R. Adhikari et al. (2021)
Is there an adequate rationale for using a mixed methods design to address the research question?	√
Are the different components of the study effectively integrated to answer the research question?	√
Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	√
Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	√
Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	√
Total	5

Appendix V. Privacy statement

(to be appended to the Participant Information and Informed Consent Forms)

Name of Research Project: Is digital simulation as effective as on campus simulation: a knowledge acquisition, confidence and economic evaluation.

Description of Project: The study will involve completing a short online workbook and them attending a session in skills. There you will be selected to take part in an online or laboratory based simulation activity. You will be invited to complete a short online pre and post intervention questionnaire which is will explore how confident you believe you are when caring for an unwell person with COVID-19 symptoms. During the intervention there will be a series of decisions that we will ask you to make. To further explore your responses we will select a sample of those who completed the questionnaire and invite them participate in a short interview with a member of the research team.

Data Controller	Edinburgh Napier University
Purposes for collection/processing	This project will generate data designed to study the evaluation of COVID-19 online interactive simulation with health care professionals and health care students who have accessed the online educational resource. The research question is: *What do health and social care students perceive the impact of a COVID-19 simulation game on confidence and knowledge acquisition?* Aims To investigate the effect of the COVID 19 simulation game compared to a face to face simulation on confidence and knowledge acquisition To explore with second and third year student nurses their perception of the acceptability and knowledge acquisition of the COVID-19 online education resource and game

Legal basis	Art 6(1)(e), performance of a task in the public interest/exercise of official duty vested in the Controller by Statutory Instrument No. 557 (S76) of 1993 as amended, e.g. for education and research purposes. Where sensitive personal data is being processed the additional bases from Article 9 is: Art 9(2)(j) for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes. This research project does not intend to collect or process any special category personal data e.g. political opinions that can be associated with you or your identity. Please do not provide any specific information of this type in your responses (e.g. names, places, dates, organisations) to research questions or during focus group discussions. In the unlikely event that special category personal data is collected, the University relies on Article 9(2)(j) for processing.
Whose information is being collected	Health and social care students who have accessed the online MOODLE resource. [Simulated practice for third year nursing students] (https://open.napier.ac.uk/course/view.php?id=34)

What type/classes/fields of information are collected	Please refer to data collection tool for full information. Participants will be identified and invited to participate from the online MOODLE platforms. No data or informatics will be extracted from the MOODLE site. On the consent form participants will be asked: Name Email phone number. In the survey participants will be asked: year of study, gender and invited to complete a validated questionnaire that explores confidence and anxiety when caring for patients who are clinically deteriorating. During the simulation activity students will be invited to prioritise care and lead the delivery of interventions. This will be measured against a set of pre-determined criteria. During the semi-structured interview data on their perceptions of the educational game will be collected. Specific details on the questions to be asked are detailed in the qualitative topic guide document, but relate to the usability and impact on knowledge acquistion of the resource and any improvement.

Who is the information being collected from	Data is being collected directly from you as the participant in the study. We have identified you through the MOODLE space that you enrolled on to access the online resource.
How is the information being collected	Survey data is being collected by the University approved NOVI survey platform. As soon as the NOVI survey data collection period closes (4-6 weeks) all data will be downloaded and transferred onto a secure storage site on the X-drive. Quantitative survey data files generated will be processed and stored electronically as SPSS system files with DDI XML documentation. Online qualitative interviews will be recorded on MS Teams and then transcribed onto a word document and imported into a secure online qualitative data storage platform, NVIVO and stored on the x drive. All textual data will be processed, anonymised and stored electronically as plain text data, and as an NVIVO file. No identifiable data will be stored.
Is personal data shared externally	No it is not, we are only contacting you because we know that you have accessed the MOODLE space. We will not share any personal data with any external source.
How secure is the information	The data will be stored on on a secure University drive (X drive) that can only be accessed by the research team.

	For services provided locally by Information Services, information is stored on servers located in secure University datacentres. These datacentres are resilient and feature access controls, environmental monitoring, backup power supplies and redundant hardware. Information on these servers is backed up regularly. The University has various data protection and information security policies and procedures to ensure that appropriate organisational and technical measures are in place to protect the privacy or your personal data. The University makes use of a number of third party, including "cloud", services for information storage and processing. Through procurement and contract management procedures the University ensures that these services have appropriate organisational and technical measures to comply with data protection legislation. The University is Cyber Essentials Plus accredited.
Who keeps the information updated	The chief investigator with be responsible for the research team ensuring any information pertaining to the study is kept up to date.
How long is the information kept for	Consent forms = 6 years Audio recordings = kept until transcription completed (within 31 days). Transcriptions (pre anonymisation) = retained for 31 days to allow verification of meaning with participant. At the end of the research analysed and anonymised data will be kept securely for ten years and then will be

	destroyed as per Edinburgh Napier University guidance on the safe disposal of confidential waste. All electronic files containing data will be deleted from the secure university server.

Appendix VI. Invitation and brief summary

Study Title: Is digital simulation as effective as on campus simulation: a knowledge acquisition, confidence and economic evaluation

The aim of this study is to compare a digital simulation with a simulation activity based in clinical skills. The researchers are investigating whether there is a difference in how much you learn and how confident you feel after participating in a simulation intervention.

You should only participate if you wish to and choosing not to participate will not disadvantage you in any way. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

What is involved?

1. completing an online educational package
2. attending the clinical skills department at Edinburgh Napier University
3. Completing a short confidence questionnaire and then participating in a simulated activity.

During the activity there will be decisions to be made with your team about the person you are caring for. On completion, we will ask you to repeat the confidence survey. To further explore your responses we will select a sample of those who participated in the digital scenario to participate in a short interview with a member of the research team.

Attendance at clinical skills will not take any more than 4 hours of your time. You can choose to take part in all, part or none of the study. Prior to taking part in the study we will obtain consent and request that you read a privacy notice which outlines how you information will be collected, stored and analysed.

What are the possible benefits of taking part?

The study may not benefit you directly but will help to inform development of additional online and distance learning resources for future nursing programmes. This is a simulated practice learning opportunity in addition to a research project and therefore, supports your learning during your programme of study.

What are the possible risks to taking part?

The risks to taking part are small, but you will have to take 3-4 hours out of your personal time in order to attend clinical skills and participate in the simulation.

Whom have we asked to participate?

We have invited all third year students to take part in the study.

How will my information be kept confidential?

Your participation in this study is confidential. All data, surveys and digitally recorded interview data will be kept securely in accordance with the Data Protection Act (1998) and GDPR legislation 2018. You can be assured that the data will be anonymised and that confidentiality will be ensured at all times. All data collected as part of the study will be stored securely on a password protected secure server that only the research team will have access.

Who has reviewed this study?

Edinburgh Napier University research governance and ethics committee have reviewed and approved the study. Partner Universities and NHS Health Boards have also granted permission.

What will happen to the results of this study?

The information in this study will only be used in ways that will not reveal who you are. You will not be identified in any publication from this study or in any data files shared with other researchers. We may be legally required to show information to university staff external to the research team, who are responsible for monitoring the safety of this study. Prior to sharing any data it will be anonymised so that you cannot be identified. The findings will inform the educational preparation of health care students in the future and the results will be shared through publishing the results and conference presentations.

What will happen if I choose not to take part now or at a later stage?

Participation is voluntary and participants are free to withdraw at any time without giving a reason. If you choose to withdraw we will destroy any data we have collected with you, this may not be possible once the data is anonymised and you will be advised of this should this happen.

For further information, please contact:

Dr Ruth Paterson, Associate Professor and Principal Investigator, Napier University: R.Paterson@napier.ac.uk

Independent advice

If you would like to speak to someone not connected to the study but with experience of research, projects please contact:Dr. Janette Pow, Lecturer, Edinburgh Napier University – j.pow@napier.ac.uk

Appendix VII. Self-efficacy assessment tool

Participant number(code)

Part i: Demographics: please answer the following

S.No	**Variable**	**Response (encircle or fill the blank space)**	**Remark**
1	Gender	Male Female	
2	Age (years)	_____	
3	Year of study	2nd year 3rd year	
4	Format of your program	Part-time Full-time	

Part ii: self-confidence and anxiety questionnaire

This is a scale to measure your confidence and anxiety when making clinical decisions. Reflect thoughtfully upon each item and answer it as accurately as possible. There is no right or wrong answer to questions in the survey. Read each of the 27 statements and choose the option which reflects how you usually feel. Answer both the self-confidence and the anxiety portion for each item.

Please score your level of self-confidence and anxiety when caring for a person with pneumonia on a scale of 1 – 6:

Self-confident	1 = Not at all	2 = Just a little;	; 3 = Somewhat;	4 = Mostly	; 5 = Almost totally	; 6 = Totally
Anxious	1 = Not at all	2 = Just a little;	; 3 = Somewhat;	4 = Mostly	; 5 = Almost totally	; 6 = Totally

	I am ___ self-confident and ___ anxious in my ability to easily see important patterns in the information I gathered from the client.
2.	I am ___ self-confident and ___ anxious in my ability to identify which pieces of clinical information I gathered are related to the client's current problem.
3.	I am ___ self-confident and ___ anxious in my ability to see the full clinical picture of the client's problem rather than focusing in on one part of it.
4.	I am ___ self-confident and ___ anxious in my ability to recall knowledge I learned in the past that relates to the client's current problem.
5.	I am ___ self-confident and ___ anxious in my ability to implement the 'best' priority decision option for the client's problem.
6.	I am ___ self-confident and ___ anxious in my ability to interpret the meaning of a specific assessment finding related to the client's problem.
7.	. I am ___ self-confident and ___ anxious in my ability to evaluate if my clinical decision improved the client's laboratory findings.
8.	I am ___ self-confident and ___ anxious in my ability to recognize the need to talk with my senior colleague to help sort-out client assessment findings.
9.	I am ___ self-confident and ___ anxious in my ability to use active listening skills when gathering information about the client's current problem.
10.	10. I am ___ self-confident and ___ anxious in my ability to assess the client's nonverbal cues.

11.	I am ___ self-confident and ___ anxious in my ability to recognize the need to review a protocol, procedure, or nursing literature to help me make a clinical decision.
12.	I am ___ self-confident and ___ anxious in my ability to decide if information given by significant other/family is important to the client's current problem. .
13.	I am ___ self-confident and ___ anxious in my ability to use my knowledge of anatomy and physiology to interpret information I gathered about the client's current problem.
14.	I am ___ self-confident and ___ anxious in my ability to act on at least one intervention I considered based on my gut-feeling or intuition.
15.	I am ___ self-confident and ___ anxious in my ability to analyze the risks of the interventions I am considering for the client's current problem.
16.	I am ___ self-confident and ___ anxious in my ability to recognize important information about a client problem from information I received during shift-change report.
17.	I am ___ self-confident and ___ anxious in my ability to INDEPENDENTLY make a clinical decision to solve the client's problem.
18.	I am ___ self-confident and ___ anxious in my ability to ask the client additional questions to get more specific information about the current problem.

19.	I am ___ self-confident and ___ anxious in my ability to correlate physical assessment findings with the client's nonverbal cues to see if they match or don't match.
20.	I am ___ self-confident and ___ anxious in my ability to implement one accurate intervention if the client is having an urgent problem
21.	I am ___ self-confident and ___ anxious in my ability to use my knowledge of diagnostic tests, like lab results or x-ray findings, to help create a possible list of decisions I could implement.
22.	I am ___ self-confident and ___ anxious in my ability to realize the need to talk with my clinical nursing instructor or the staff nurse about interventions I am considering.
23.	I am ___ self-confident and ___ anxious in my ability to remain open to different reasons for the client's problem even though the information I gathered may point to only one reason.
24.	I am ___ self-confident and ___ anxious in my ability to ask the client's significant other/family questions to gather information about the current problem.
25.	I am ___ self-confident and ___ anxious in my ability to evaluate if the clinical decision I made influenced client satisfaction.
26.	I am ___ self-confident and ___ anxious in my ability to incorporate personal things I know about the client in order to make decisions in his or her best interest.

27.	I am ___ self-confident and ___ anxious in my ability to consider a possible intervention for the client's problem just because it 'seems' right.

Thank you for completing this questionnaire.

At the conclusion of the scale items (either paper copy or electronic) include the following notation:

Appendix VIII. Data Collection Form: Evaluation of Clinical simulation versus digital simulation: assessment of knowledge.

Participant Unique Identification number:

Scenario Digital/Online.

Introduction:

This is the running order for the in person simulation and mirrors the digital simulation. As a facilitator you should provide the student with any information they request. Please be as supportive as you can be and offer any prompts as you see fit.

Part 1:

Hi fidelity sim – the patient will appear breathless and will not be monitored, the first assistant will provide the following handover.

Hello xxxx, thank you for reviewing this patient – this is a 35 year old previously fit and healthy male presenting with 10 day history of pyrexia, cough and increasing shortness of breath. No history of him or any family members travelling to a foreign country in the past 3 weeks. I have completed a brief history and examination and here are his notes.

A. Immediate Care and management

1. What's our first course of action? (Pick-3)

1. Vital signs	2. NEWS2 Score	3. Sit patient upright

4. Comprehensive history	5. Allergies	6. Sputem

2. Which mask to use and how much percentage of Oxygen to be given? (pick1)

1. Hudson mask	2. Nasal canulla	3. Non-bre

Oxygen %=……..% OR ……..litres

3. What combination of blood tests are the priority here? (pick 1)

1. Blood culture, blood gas, urea and electrolytes and full blood count
2. Blood gas including lactate, urea and electrolytes, full blood count and cross match
3. Blood gas including lactate, blood culture, urea and electrolytes, full blood count LFTs, C-reactive protein and blood glucose
4. Blood culture, urea and electrolytes and full blood count, LFTs

4. What type of and how much IV fluid would you like to give? (pick 1)

1. 0.9% saline	2. Plasmalyte	3. Discuss fluid further

Volume……..ml …….mins

B. Full history examination and diagnosis

5. What further investigations would you like to do?(pick 1)

1. CT scan ECG and sputum, U&Es and CRP
2. Pulmonary CT, D-Dimer and ECG, U&Es and CRP
3. Chest x ray, respiratory examination and urinalysis, U & Es and CRP
4. Chest x ray, respiratory examination, ECG, sputum, U&Es, CRP, ABG, viral nasal and throat Swabs.

6. What can you hear when you place cursor/stethoscope over the patients lung field? (pick 1)

1. Bibasilar Crackles	2. Pleural rub left side
3. Wheeze throughout	4. Bronchial breath sound right lower lobe

5. Normal vesicular breath sound throughout	6. Absent breath sounds left side

7. Here's the patient's X-ray. Can you see a problem in chest X-ray?

1. Yes	2. No

If so, indicate where on the x-ray and answer what that problem indicate? (pick 1)

1. Left side consolidation
2. Right side consolidation
3. Pulmonary embolism
4. Heart Failure
5. Bilateral pulmonary atelectasis consistent with COVID pneumonia

8. Please interpret these blood gases (this data was collected when the patient was on no oxygen therapy) (pick 1)

1. Respiratory Acidosis
2. Respiratory Alkalosis
3. Metabolic Acidosis
4. Metabolic Alkalosis

9. Please Calculate the CURB 65 using the information you have gathered and the blood results. (pick 1)

1. 0-1	2. 2	3. 3-5

10. What do you think the diagnosis is ? (pick 1)

1. Pulmonary embolism
2. Heart failure
3. Viral pneumonia secondary to COVID-19
4. Pneumothorax

C. Medication and treatment

11. What do you think should be administered? (pick-2)

1. Metronidazole	2. Flucoxacillin
3. Dexamethasone	4. Co-amoxiclav
5. Doxycycline	6. Amoxicillin
7. Gentamicin	8. Piperacillin/Tazocin
9. Clarithromycin	

12. How should the medication be administered? (pick 1)

1. Orally	2. Intravenously

13. What dose and the frequency of each medication should be prescribed?(pick 2)

Co-amoxiclav	
1. Co-amoxiclav 600mg 12 hourly	2. Co-amoxiclav 600mg 8 hourly
3. Co-amoxiclav 1.2g 8 hourly	4. Co-amoxiclav 1.2g 6 hourly
Dexamethasone	

5. Dexamethasone 2mg twice daily	6. Dexamethasone 12mg once daily
7. Dexamethasone 8mg twice daily	8. Dexamethasone 6mg once daily

14. What do you think the ongoing treatment should be? (pick 3)

1. Discharge to home	2. Humidified oxygen
3. Refer to ward	4. Chest physio
5. Refer to a critical care area	