



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

Student Nurses' Perception of Virtual Simulation: A Qualitative Study

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That the Master's Thesis submitted by Anu Koju, entitled 'Student Nurses' Perception of Virtual Simulation: A Qualitative Study' carried out under our supervision in the Erasmus Mundus Joint Master Degree in Emergency and Critical Care Nursing, meets the requirements to be approved as a Master's Thesis.

And for the record, and the relevant purposes, the present certification is issued in Edinburgh on (February 2022).

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Glossary of terms

VS- Virtual simulation

CS- Clinical Simulation

CASP- Critical Appraisal Skills Program

PEO- Population, Exposure, and Outcome

PRISMA- Preferred Reporting Items For Systematic Reviews and Meta-analysis

VSG- Virtual Simulation Game

VP- Virtual Patient

ENU- Edinburgh Napier University

NASC-CDM- Nursing Anxiety and self-Confidence with Clinical decision-making

Definition

Simulation- *“Simulation is defined as a technique that creates a situation or environment to allow persons to experience a representation of a real event for practice, learning, evaluation, testing, or to gain an understanding of systems or human actions”* (Lioce, 2020)(p-44).

Virtual simulation- *“Virtual simulation is a simulation that use a variety of immersive, highly visual, 3D characteristics to replicate real-life situations and/or health care procedures; virtual reality simulation is distinguished from computer-based simulation in that it generally incorporates physical or other interfaces such as a computer keyboard, a mouse, speech and voice recognition, motion sensors, or haptic devices (ASSH)”* (Lioce, 2020)(p-44).

On-campus simulation- *“The use of manikins to represent a patient using heart and lung sounds, palpable pulses, voice interaction, movement (e.g., seizures, eye blinking), bleeding, and other human capabilities that may be controlled by a simulationist using computers and software”* (Lioce, 2020)(p-31).

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Student Nurses' Perception of Virtual Simulation: A Qualitative Study

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Abstract

Background: Virtual simulation(VS) is an innovative, computer-generated teaching-learning and assessing activity that is suitable for professional growth, ongoing training, and academic education. Since VS is novel pedagogy in nursing education, there are a variety of views and scarcity of research on the effectiveness of the VS for a teaching-learning process to nursing students, as well as their perceptions on its usability and applicability. Similarly, no studies have evaluated nursing students' perceptions of the influence of VS on decision-making skills and its comparison to clinical simulation, as far as the researcher is aware.

Aim: This study aimed to identify and evaluate the nursing students' perception of VS in the context of impact, confidence, clinical decision-making skill, and comparison with clinical simulation.

Methods: A qualitative descriptive study was conducted on a convenience sample of 17 nursing students using one-to-one interviews. Interviews were digitally recorded and transcribed using an online platform: Microsoft Teams. Data were analyzed using an abductive thematic analysis approach.

Results: The four major themes that emerged were: 1. Confidence, 2. Applicability, 3. Comparison with clinical simulation, and 4. Usability and Areas of development. The participants were impressed with the enhancement of their confidence, knowledge, and decision-making skills after involving in VS. While comparing VS with CS, they perceived that the VS was more efficient, effective, and informative than CS.

Conclusions: The participants perceived the VS as a useful and applicable tool to enhance their confidence, knowledge, and decision-making skills. They also expressed that VS can not only complement but also replace the clinical simulation where presential simulation is not viable.

Chapter 1 – Introduction

1.1 Introduction and Background

Simulation-based learning is an important element of the teaching-learning process in medical education that enables a secure setting for learners to acquire, refine and demonstrate their understandings and clinical performances without endangering the patients (Bond & Spillane, 2002; Chang et al., 2021; Hanshaw and Dickerson 2020). Students can improve knowledge, sensory-motor skills, and self-confidence through observation, persistence practice, and reinforcement of simulation (Bradley, 2006). In a systematic review conducted on the pre-licensure health education to determine the effectiveness of simulation (n=23), high student satisfaction with clinical skills learning, improved knowledge, and skill performance were observed (Laschinger et al., 2008). According to the Nursing and Midwifery Council (NMC 2021) the UK, out of 2300 practice learning hours, up to 600 hours can be supplied through simulation. However, incorporating simulation into the educational process is both a remedy and a difficulty (Bradley, 2006). The drawbacks of simulation include costly technology, time-consuming, and limited availability of resources (Bond & Spillane, 2002) as well as distraction and reluctance to methodological change in the teaching-learning process (Campos et al., 2020). Hence, it is neither encouraged to replace all real-life experience with simulation nor to discard other training strategies (Washburn & Zhou, 2018), instead can be used to teach unpredictable and life-threatening conditions (Bond & Spillane, 2002).

Based on the educational goals and technologies used, simulation can be of two forms using various types of simulators. They are 1. Face-to-face clinical simulation(CS) using part-task trainers (models of body part or structure), simulated patients and environments (role play), and integrated simulators (medium or high fidelity manikin) and 2. Virtual simulation(VS) which are computer-based systems, multimedia programs, interactive systems, and virtual reality (Bradley, 2006). CS is often conducted in class following regular textbook reading and in-person lectures by a familiar professional while VS can be run unlimited times at any time without the need for face-to-face communication (Campos et al., 2020; Wiese, Love, and Goodman 2021). Moreover, numerous students can involve in VS at the same time (Triola et al., 2006). Both of these simulation strategies can assist students to improve their skills, confidence, and reducing anxiety before being exposed to a real-life clinical scenario

(Cobbett & Snelgrove-Clarke, 2016).

With the tremendous advancement of digital technologies, the concept of VS is now receiving attention in nursing education (Foronda et al., 2020). It has the potential to be widely used and to meet the needs of nursing students in today's world (Leibold & Schwarz, 2017). Due to its convenience and cost-effective option in continuing education without the need to leave the home, it is also applicable in developing countries (Leibold & Schwarz, 2017). Various VS have been developed to enhance the skills and understandings of the nursing students. For instance: vSim for Nursing (Donovan et al., 2018), International clinical nursing skills mobile application(ICNS app) (H. Kim & Suh, 2018), SimuCase (Clinard & Dudding, 2019), ComEd program (Lee et al., 2021), and so on. According to a systematic review spanning 1996 to 2018 conducted to determine the impacts of VS on learning outcomes of nursing students (n=80), Foronda et al., (2020) reported 86% of articles revealed enhanced learning outcomes. Additionally, VS has enhanced learners' clinical skills, critical thinking, self-confidence, and satisfaction (Foronda et al., 2020). It may also be used as a tool to assess students' learning in the future (Washburn & Zhou, 2018). Yet, there are some obvious challenges with using VS. These include human expertise, time, money, software, equipment, and so on (Leibold & Schwarz, 2017). However, the effectiveness of VS has been demonstrated in all high-incomed, middle-incomed, and low-incomed nations (Kononowicz et al., 2019).

Currently, Corona Virus Disease 2019- an infectious disease in the form of a terrible pandemic is currently afflicting the world (Cucinotta & Vanelli, 2020). According to the WHO Coronavirus(COVID-19) Dashboard updated on 1st February 2022, there were 376,478,335 confirmed cases with 5,666,064 deaths due to coronavirus infection. As a quickly growing scenario due to its significant possibility for human-to-human transmission (Siordia, 2020), this outbreak has impacted all the members of society and created great disruption in all the sectors of life, not only in the medical but also to educational sectors; due to the implementation of strict lockdown, closing all organizations and schools, social distancing, and placing broad limits on people's movement, even confining them to their houses (Currie et al., 2020; Douglas et al., 2020; Taylor et al. 2020). Despite all, mortality rises in direct proportion to the severity of the disease; and early diagnosis and individualized management of acutely ill patients remains the most important measures taken for improving health outcomes (Sun et al., 2020; Wang et al., 2020). Hence, preparing the medical force

through the teaching-learning process to deal with this scenario is the need of today. However, the traditional clinical practice for students was difficult to anticipate during the pandemic, and incorporating VS has evolved as both a safe and reliable pedagogical strategy to learn and enhance their clinical skills (Daniel 2020; M. J. Kim et al., 2021). Fogg et al., (2020) surveyed to evaluate the efficacy of the shift from traditional simulation to VS utilizing a 5-point Likert scale in the USA where more than half of the nursing student participants(53%) agreed or strongly agreed that involvement of VS provided great learning opportunities.

Hence, NHS Education for Scotland in collaboration with teams from Edinburgh Napier University developed the VS: COVID-19 scenario game. It was created to provide knowledge to nursing students regarding early recognition and treatment of a person acutely unwell with suspected COVID-19. In this game, participants can interact with audio, visual, and stimuli. After each interaction, the game displayed an alarm sign for the allotted time. It won't allow the next interaction unless the previous step is completed. Additionally, it consists of a list of nursing interventions that students can utilize as needed. During the VS experience, students' nursing care actions were automatically recorded and evaluated. It was designed to be compatible with any windows computer and started via a link. The entire VS lasted for about 30 minutes.

It was evidenced that VS allowed students to detect and correct errors, resulting in improved clinical skills and competency (Foronda et al., 2020; Kononowicz et al., 2019). However, students may still feel uncomfortable and stressed due to a lack of awareness in a complex clinical situation (Thompson, 2021). Thus, it was suggested to examine the perception of learning in VS, which was important to validate their learning, confidence, critical thinking, and satisfaction (Sigalet et al., 2012). Additionally, there were conflicting views and scarcity of the study on how effective the VS was in terms of its usability and applicability as VS is a novel concept in nursing education (Foronda et al., 2020). Hence, this qualitative study will provide insight into Second- and Third-year nursing students' perceptions of VS in the context of impact, confidence, clinical decision-making, and comparison with CS.

1.2 Justification of the study

Simulation is an important aspect of medical education (Bond & Spillane, 2002; Bradley, 2006). NMC(2021), UK declared that out of 2300 practice learning hours, up to 600 hours can be supplied through simulation. Usually, the students perceived advancement in knowledge, communication skills, nursing procedures, critical thinking, and growth in self-efficacy in a traditional clinical context, which is considered as the ‘Gold Standard’ (Badowski et al., 2021). However, with the rapid development in technology and flexibility of VS, it has grown in popularity in recent years to meet the needs of nursing students (Bradley, 2006). Additionally, it is gaining wide attention as a teaching-learning approach in the COVID-19 quarantine rule and social distancing that prompted a sudden transition from face-to-face to the VS as an instant reaction and obvious restriction to clinical posting (Camargo et al., 2020; Peachey et al., 2021).

With the possibility of a fourth wave of COVID-19 pandemic, the application of VS will remain a significant approach for clinical practice, and set guidelines for its use have been proven to be a crucial component of the safe pandemic response (Peachey et al., 2021). However, there are different perspectives and a paucity of research on the utility and applicability of the VS due to its novelty in nursing education (Foronda et al., 2020). Hence, it is important to explore the impact of VS as an educational approach, barriers during applications, and opportunities for additional improvement from the learners’ perspectives (M. J. Kim et al., 2021). This qualitative study will provide insight into how meaningful learning is as experienced and perceived by nursing students using VS in terms of its impact, confidence, decision-making skills, and comparison with CS. Through the dissemination of findings at conferences and journal publications, the study will contribute to the evidence in filling a literature gap that may act as a catalyst for further research in this area as well as the development of additional evidence for its utilization.

1.3 Research questions

- What are the perceptions of nursing students on VS with regards to impact, confidence, decision-making skills, and how it compared to CS?

1.4 Research aim and objectives

Aim: This study will aim to identify and evaluate the nursing students' perception of VS in terms of impact, confidence, decision-making skills, and comparison with CS.

Objectives:

- To explore the nursing students' perceptions of VS in terms of impact, confidence, decision-making skills and
- To compare those perceptions and experiences with CS.

1.5 Operational definitions

Virtual Simulation- COVID-19 scenario game created in the context of management of COVID-19 pneumonia

Nursing Students- Second- and third-year nursing students of Edinburgh Napier University

1.6 Theoretical concept behind COVID-19 scenario game

The COVID-19 scenario game was developed with the concept based on gaming theory. Research has indicated that students are enthusiastic about the digital game (Van Rooij et al., 2011) and devote a large amount of time to it (Paraskeva et al., 2010). Moreover, games were believed to have a great chance of becoming an effective and enjoyable instructional tool that will raise student engagement, motivation, and learning performance (Paraskeva et al., 2010; Whitton, 2011). In a scoping review conducted to evaluate digital game-based learning and its impact on achievement and learning outcomes (n=14), Turner et al., (2018) emphasized the value of games in improving critical thinking abilities and topic understanding. Games also provide students with fresh knowledge (Paraskeva et al., 2010), emotional connections to the actions (Lamb et al., 2018), and rapid feedback on their activities and decisions, which encourages development and innovation (Charles et al., 2011; Kirriemuir, 2002). In addition, the game offers a sense of security for students to take risks without endangering themselves or others, while also allowing them to play at their speed without feeling rushed or ashamed

in front of others (Han, 2015).

While designing the COVID-19 scenario game, the idea of gaming theory was translated to the VS where students derived satisfaction and knowledge acquisition in an interactive virtual environment. A virtual environment simulates a high-level of a real-life scenario, enabling students to enjoy learning and improve knowledge, involvement, and self-confidence from anywhere, at any time, and may be considered a cost-effective and convenient substitute for a CS (Verkuyl et al., 2017; Verkuyl & Hughes, 2019). Hence, this game consists of three integral components: gaming, simulation, and learning through feedback. This study was conducted to find out how nursing students felt about VS in the context of impact, confidence, decision-making skills, and comparison with CS.

1.7 Dissertation structure

- In chapter-1, the study's context has been introduced. The research objectives and questions have been identified along with the significance of the study.
- In chapter 2, the existing literature on the students' perception of VS will be reviewed. This review will include primary qualitative studies and a qualitative approach of mixed-method studies.
- In chapter 3, the theoretical framework of methodology will be presented. The adoption of a qualitative research approach will be justified and discussed, including the limitations.
- In chapter 4, the finding of the research will be presented.
- In chapter 5, the study's findings will be analyzed, discussed, and compared with the existing research findings
- In chapter 6, the conclusion of the dissertation will be presented with the implication and recommendations for future studies.

Chapter 2 – Literature review

This chapter illustrates a comprehensive review of the existing literature for accessing insight into students' perspectives on VS. It consists of a brief introduction, aims of this review, a method applied in literature search, and the results which include the quality appraisal of searched articles and their findings. Additionally, it also comprises the discussion of the qualified articles and their limitation, which ultimately leads to the identification of the literature gaps.

2.1 Introduction

Virtual simulation(VS) is an innovative, computer-generated teaching-learning and assessing activity that is suitable for professional growth, ongoing training, and academic education (Byrne et al., 2010). It includes interactive elements, such as questions that the user must answer using the computer keyboard to go through the content (Wiese et al., 2021). It is a secure-practice environment that can be accessed at any time and from any location for unlimited times to promote safe student-centered learning (Foronda et al., 2020; Triola et al., 2006). It enables students to learn particular abilities until they master them, which can help them achieve a greater degree of psychomotor competence and emotional aspects of learning, both of which are important for confidence building (Kim et al., 2021).

In nursing education, VS is a comparatively recent concept that has been shown to increase students' learning achievements (Foronda et al., 2020). Moreover, it has been rapidly expanding to address the requirements of today's student nurses (Wiese et al., 2021). There is evidence that simplicity of use, usability, and involvement of VS are beneficial, but further research on users' experience and perception is necessary to confirm their effectiveness (Byrne et al., 2010; Kim et al., 2021). Hence, primary qualitative studies and qualitative approach of mixed-method studies based on participants' perception of VS were evaluated in this review. The aims of this review are:

1. To give an outline and empirical evidence for healthcare students' perceptions and experiences with VS and

2. To access the quality of existing research related to students' opinions on VS.

2.2 Methods

The researcher opted to do a meta-synthesis that integrate the qualitative studies and qualitative approach of mixed-method studies conducted to explore the participants' perception of VS. Meta-synthesis is a systematic review and deeper integration of results from qualitative studies that strikes a proper balance between three elements: an objective and unbiased structure that involves study selection, inclusion, and appraisal; an intensive strategy for data analysis; and the required involvement of the researcher's individuality in the ultimate project (Lachal et al., 2017). It's an integration study that aids to combine all the findings from previous qualitative studies (Sandelowski & Barroso, 2003).

2.2.1 Review questions

1. What are the healthcare students' perceptions and experiences on using VS according to the existing literature?
2. What is the nature and quality of the existing evidence relating to VS?

2.2.2 Search strategy

On October 2nd, 2021, the search method was implemented. A thorough search in the five electronic databases (Medline, CINAHL, APA PsycINFO, PubMed, and the Cochrane Library) were done. We utilized a combination of dictionary phrases and free-text words to maintain sensitivity and accuracy. This method increases the number of possibly related articles found while ensuring the quality of reliability (Shaw et al., 2004). The Boolean operators 'OR' and 'AND' were used with four clusters of keywords listed in Table 2.1.

Table 2.1: MeSH terms used in the search strategy.

(digital simulation[Title] OR virtual simulation[Title] OR computer simulation[Title])
AND
(nurs*[Title] or medic*[Title] or healthcare*[Title])
AND
(student[Title])
AND
(perceptions OR attitudes OR opinion OR experience OR view OR reflection OR beliefs)

2.2.3 Selection criteria

Various inclusion and exclusion criteria (Table 2.2) were established for selecting the studies based on the PEO acronym i.e. Population, Exposure, and Outcome. Since there were few articles a decades before, only the article from January 2011 to September 2021 published in the English language were considered.

Table 2.2: Inclusion and exclusion criteria for the study

PEO acronym	Inclusion Criteria	Exclusion Criteria
Population	-Healthcare students- pre-registered nursing students, student nurses, midwives, medical students	-Non-medical students
Exposure	-Studies related to virtual or digital or computer-based simulation	-Studies related to other forms of simulation -Studies related to comparing one type of VS with another.
Outcome	Perception or experience or opinion	
	-Primary qualitative study -Qualitative approach of a mixed-method study	-Primary quantitative study -All other studies- conference papers, Dissertation, Editorials, and Opinion pieces

2.2.4 Selection process

The results were imported into Mendeley Desktop Version 1.19.8-win32 for the duplication

screening. In the first step of selection, two members individually reviewed all titles and abstracts and chose articles that met our selection criteria (Table 2.2) while the entire articles were thoroughly assessed in the second step. The selection procedure was depicted in a flow-chart (Figure. 2.1).

2.2.5 Quality Assessment

Following the retrieval of the literature, a detailed quality assessment was conducted using CASP (Programme, 1994) to determine its strength and inadequacies. It is the most often used tool (Hannes & Macaitis, 2012) and covers all of the concepts and premises that drive qualitative research (Tong et al., 2012). It comprises 10 questions that aid in determining the qualitative study's validity and excellence (Programme, 1994). It provides obvious clues to explore when answering the checklist's questions with 'yes', 'no', or 'can't tell', making it easier to utilize.

2.2.6 Data extraction, analysis, and synthesis

The framework of meta-synthesis by Lachal et al., (2017) guided data extraction, analysis, and synthesis. The precise data of each study was retrieved and tabulated systematically to identify the scope of the study, its participants, location, and methodology. Data analysis and synthesis of selected studies were performed by team members. Firstly, each study was read and re-read thoroughly to familiarize, organize, compare, and verify the data. Subsequently, two members coded the data using MS word. These codes were combined and categorized into a framework that involved comparing themes across the articles to ensure similarities. Finally, analytical themes (Figure 2.2) were derived and interpreted by the researcher during the data synthesis. Our synthesis mainly focused on the students' perceptions of using VS.

2.3 Search results

The procedure for filtering the studies being retained in the review was illustrated using a 'Preferred Reporting Items For Systematic Reviews and Meta-analysis (PRISMA) flowchart (Figure. 1). The Primary search approach yielded 107 studies from various databases. The

findings of the databases were then loaded into a Mendeley desktop for duplicate removal, yielding 68 distinct articles for the next step. After assessing the titles and abstracts against the inclusion and exclusion criteria in the second step, 29 studies were eliminated. In the third step, full texts of 39 possibly relevant studies were examined, resulting in 7 articles that were qualified for the review.

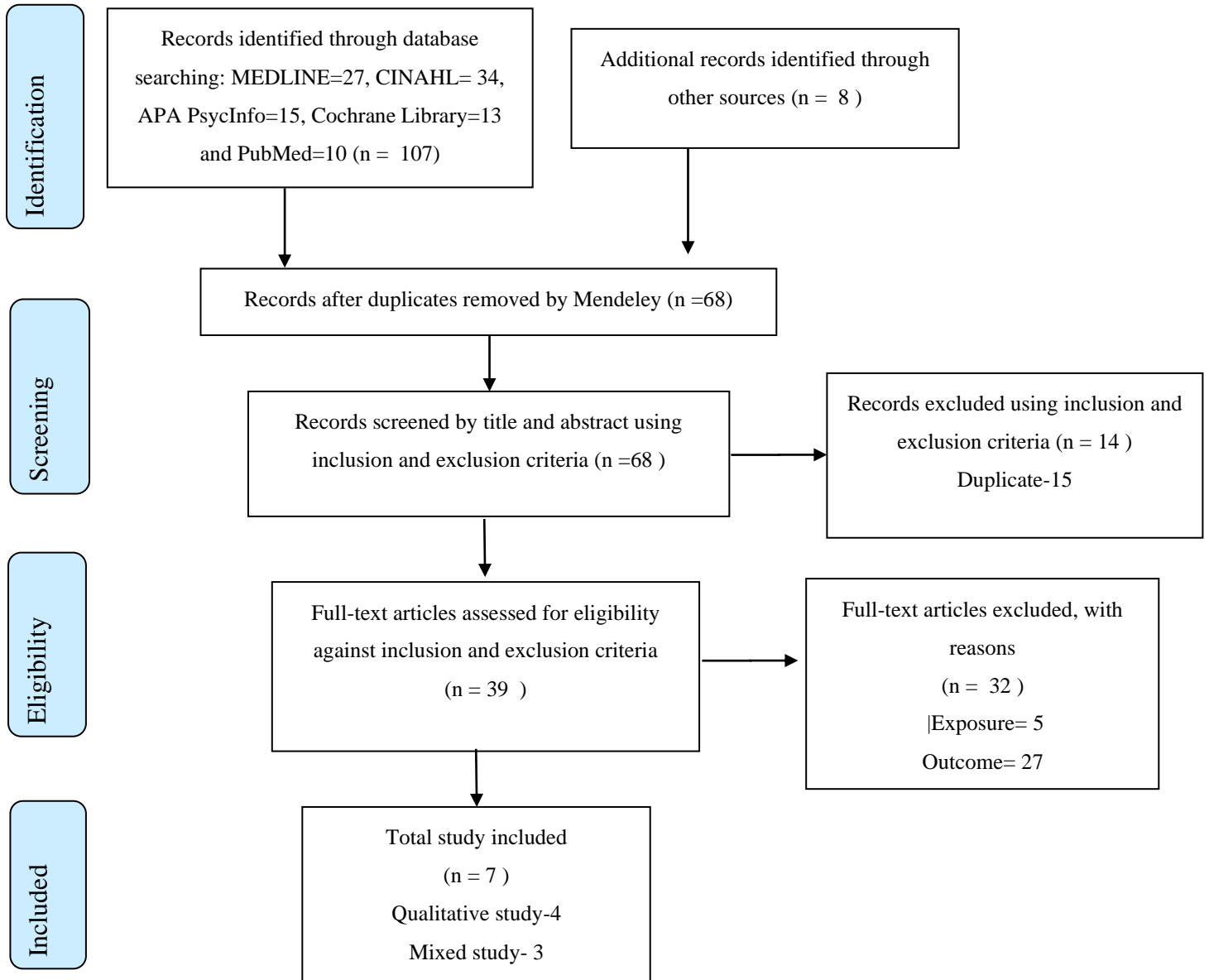


Figure 2.1: PRISMA Flowchart

2.3.1 Quality Assessment of included studies

After evaluating the quality of the articles by CASP (Programme, 1994), only one study was conceived as strong, two as moderate, and the remaining 4 as weak. Most of the studies revealed the recruitment strategy adopted as a flaw. For instance: convenience sampling in heterogeneous studies (Carrard et al., 2020; Donovan et al., 2018; Kim et al., 2021; Luctkar-Flude et al., 2021; Verkuyl et al., 2019) may result in bias due to voluntary participation. Apart from this, no discussion is made for using the particular research design in the studies (Carrard et al., 2020; Edeer & Sarikaya, 2018; Kim et al., 2021; Luctkar-Flude et al., 2021). Hence, these studies included both strengths and weaknesses to add value to the literature.

Table 2.3. Quality appraisal of the qualitative studies done by using the CASP checklist

Authors and years	Was there a clear statement of the aims of the research?	Is a qualitative methodology appropriate?	Was the research design appropriate to address the aims of the research?	Was the recruitment strategy appropriate to the aims of the research?	Was the data collected in a way that addressed the research issue?	Has the relationship between the researcher and participants been adequately considered?	Have ethical issues been taken into consideration?	Was the data analysis sufficiently rigorous?	Is there a clear statement of findings	How valuable is the research?
Carrard et al., (2020)	Yes	Yes	Can't tell - No discussion is done on how they decided to use this method.	Can't tell - No discussion is done why some people chose not to take part.	Yes	No	Yes	Yes	Yes	Weak
Kim et al., (2021)	Yes	Yes	Can't tell - No discussion is done on how	Can't tell - No comment is made why some people	Yes	No	Yes	Yes	Yes	Weak

			they decided to use this method.	chose not to take part.						
Edeer & Sarikaya, (2018)	Yes	Yes	Can't tell -No discussion is made for the rationale for using the phenomenological approach.	Can't tell -No discussion is done why some people chose not to take part.	Yes	Yes	Yes	Yes	Yes	Moderate
Liaw et al., (2021)	Yes	Yes	Yes	Can't tell -Chances of social desirability bias	Yes	No	Yes	Yes	Yes	Moderate
Donovan et al., (2018)	Yes	Yes	Yes	Can't tell -Chances of social bias due to voluntary participation	Yes	No	Yes	Yes	Can't tell -Some examples of the student's narratives are given but no mention of any differences in focus	Weak

									groups.	
Luctkar-Flude et al., (2021)	Yes	Yes	Can't tell - No description of the rationale for using the qualitative approach.	Can't tell -Chances of bias due to convenience sampling.	Can't tell -No discussion was made on how qualitative feedback is taken.	No	Yes	Can't tell -No description of the analysis process.	Yes	Weak
Verkuyl et al., (2019)	Yes	Yes	Yes	Can't tell -Chances of bias due to convenience sampling.	Yes	Yes	Yes	Yes	Yes	Strong

2.3.2 Study Characteristics

All qualified studies were conducted in developed countries where two from Canada, and each one was from Switzerland, South Korea, Turkey, Singapore, and the USA. Four out of seven studies were primary qualitative studies (Carrard et al., 2020; Edeer & Sarikaya, 2018; Kim et al., 2021; Liaw et al., 2021) and three were mixed studies (Donovan et al., 2018; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). The purpose of all the selected studies was to examine the students' perception of VS. All of the research was completed after 2018.

The demographics analyzed in the selected studies included nursing students (n=5), medical students (n=1), and students from various healthcare courses (n=1) with a total of 292 participants. Only one study was conducted in 4 different nursing schools while the remaining were single-centered. The VS used in these studies were vSim® for nursing, screened-based computer simulation, three-dimensional virtual world, video-based virtual simulation game, and Body Interact™ simulation.

Five studies utilized convenience sampling to recruit the participants (Carrard et al., 2020; Donovan et al., 2018; Kim et al., 2021; Luctkar-Flude et al., 2021; Verkuyl et al., 2019) whereas Liaw et al., (2021) employed purposive sampling and Edeer & Sarikaya, (2018) used targeted sampling method. For data collection, Luctkar-Flude et al., (2021) utilized qualitative feedback, Verkuyl et al., (2019) used individual semi-structured interviews, and in the remaining 5 studies, researchers used focus group discussion (Carrard et al., 2020; Donovan et al., 2018; Edeer & Sarikaya, 2018; Kim et al., 2021; Liaw et al., 2021). Four studies utilized thematic analysis as a data analysis method (Carrard et al., 2020; Donovan et al., 2018; Liaw et al., 2021; Luctkar-Flude et al., 2021) while content analysis was employed in the remaining (Edeer & Sarikaya, 2018; Kim et al., 2021; Verkuyl et al., 2019).

The following table shows the features of the articles selected for this review.

Table 2.4: Characteristics of a study done by Carrard et al., (2020)

Author, year, study title Country	Study's Aims/ Objectives	Sample size & participants demographics	Methods of data collection	Intervention/ Exposure	Data analysis	Results	Quality Assessment
Carrard et al., (2020) Virtual patient simulation in breaking bad news training for medical students Valerie Place: Switzerland	To find out the student's thoughts about the benefits of a virtual patient simulation as part of breaking bad news(BBN) training in undergraduate medical school.	Population: Fourth-year medical students Sample size: 23 Samples: 13 Male and 10 Female Sampling technique: convenience (those who voluntarily participated)	Qualitative study: Focus group study Training session ↓ A follow-up focus group (average time: 60min) ↓ Transcribed verbatim	On-screen 2D avatar of a patient to whom students had to deliver the news of terminal gastrointestinal cancer. Exposure time: for about 45 min.	Thematic analysis	-4 main themes and sub-themes based on the data 1. Theme A: Value -Students emphasized the importance of VS as a stress-free environment, effectiveness of self-observation, and communication competence exam. 2. Theme B: Skills developed -Students focus on the improvement of various communication skills such as verbal and non-verbal communication skills and handling their emotions and feelings with the help of VS. 3. Theme C: Limitation -Some students confronted that VS is confined to technological aspects. 4. Theme D: Areas of improvement -Areas of improvement included interactivity of VPs, quality of avatars, and virtual reality scope.	Weak

Table 2.5: Characteristics of a study done by Kim et al., (2021)

Author, year, study title Country	Study's Aims/ Objectives	Sample size & participants demographics	Methods of data collection	Intervention/ Exposure	Data analysis	Results	Quality Assessment
Kim et al., (2021) Nursing Students' Perceptions and Experiences of Using Virtual Simulation During the COVID-19 Pandemic. Place: South Korea	-To learn about the opinions and experiences of a pre-licensure nursing student with virtual simulation as a substitute for clinical practice during the COVID-19 pandemic in South Korea.	Population: 4-year baccalaureate nursing students Sampling technique: convenience sampling (those who voluntarily participated and met inclusion criteria) Sample size: 20 Samples: 16 female and 4 male The average age of samples: 22.3 (± 1.17)years	Qualitative study: Descriptive qualitative study Method: Focus group interviews using Zoom video communications with 3-4 participants	Virtual simulation (vSim® for nursing) was co-developed by Wolters Kluwer Health Lippincott and Laerdal Medical in collaboration with the National League for Nursing (NLN) in the United States.	Qualitative content analysis	- 3 main themes and sub-themes 1. Difficulties encountered in using VS -VS provided in the English language -Unfamiliarity with VS 2. Benefits to student confidence and competence to provide patient-centered care -Opportunities to care for the patient alone -Opportunities to enhance abilities 3. Gaps in satisfaction due to need for improvements -Lack of reality and limited function -Confirming the level of achievement and evaluation	Weak

Table 2.6: Characteristics of a study done by Edeer & Sarikaya, (2018)

Author, year, study title Country	Study's Aims/ Objectives	Sample size & participants demographics	Methods of data collection	Intervention/ Exposure	Data analysis	Results	Quality Assessment
Edeer & Sarikaya, (2018) Views, Perceptions, and Recommendations of Nursing Students about a Screen-Based Computer Simulation: A Qualitative Study Place- Izmir, Turkey	To learn about the perspectives of second-year undergraduate nursing students on screen-based computer simulation (SBCS), as well as their views and suggestions for how the training course could be improved.	Participants: second-year undergraduate nursing students Sampling technique: Targeted sampling method Sample size: 24 participants Samples: 20 Females and 4 male The average age of the sample: 20.2±0.8 years	Qualitative study: Phenomenological approach Method: focus group discussion with 12 participants in each group. (average time: 60 minutes)	Screened-based computer simulation (SBCS) focusing on preoperative and postoperative care management	Content analysis using the inductive method	Five main themes 1. Theme 1: Learning - SBCS offered extensive and adequate pre-and post-operative care instructions with acceptable understandings. 2. Theme 2: Practice - SBCS enhanced their self-confidence, communication skills, and the number of errors they made. 3. Theme 3: Barriers - Students felt technical difficulties(internet access) while utilizing SBCS. 4. Theme 4: Attractions - SBCS was easy to understand, appealing, re-use and promote learning 5. Theme 5: Recommendations for simulation - Increase in visual materials - Provision of immediate feedback - Emphasized self-assessment - Supported by practice in skill lab	Moderate

Table 2.7: Characteristics of a study done by Liaw et al., (2021)

Author, year, study title Country	Study's Aims/ Objectives	Sample size & participants demographics	Methods of data collection	Intervention/ Exposure	Data analysis	Results	Quality Assessment
Liaw et al., (2021) “Wow, woo, win”: Healthcare students’ and facilitators’ experiences of interprofessional simulation in the three-dimensional virtual world: A qualitative evaluation study Place: Singapore	To elucidate healthcare students' and facilitators' experiences with the three-dimensional virtual world for inter-professional team-based virtual simulation.	Participants: Full-time senior healthcare students and facilitators Sampling technique: Purposive sampling Sample size: 42 Samples: 30 healthcare students and 12 facilitators from 6 healthcare courses The average age of the sample: 22.6 years (SD=1.72)	Qualitative study: Qualitative descriptive design Method: 1.Focus group discussion- 6 heterogeneous focus groups with 4-6 healthcare student participants (average time: 53min) and 2.Individual interviews for facilitators with semi-structured interview guide (average time: 45-60min)	Three-dimensional virtual world (3DVW) simulation for total knee replacement Exposure time: 2 hours	Thematic analysis	4 main themes 1. “wow” experience - Amusement with technology -Inter-professional growth 2. Authentic experience in collaborative care - Growth of interprofessional collaboration -Feeling of realism of the scenario 3. Ease of learning - Discovered that learning was simpler & less anxious using 3DVW with active convenience participation and engagement. 4. Preminent role of the facilitator - The facilitator’s involvement was emphasized as crucial in learning for offering clear guidelines and directions.	Moderate

Table 2.8: Characteristics of a study done by Donovan et al., (2018)

Author, year, study title Country	Study's Aims/ Objectives	Sample size & participants demographics	Methods of data collection	Intervention/ Exposure	Data analysis	Results	Quality Assessment
Donovan et al., (2018) Computer-based simulation: Effective tool or hindrance for undergraduate nursing students? Place: USA	To explore nursing students' perspectives and experiences with the computer-based simulation provided before participating in the simulated lab environment	Population: Third semester medical-surgical nursing students Sampling technique: Convenience (participated voluntarily) Sample size: 82 Samples: 77 females and 5 males The age range of participants: 20-25 years	Mixed method study: 1. Quantitative study: Online survey Pre-test survey ↓ vSim for the nursing program ↓ Post-test survey -10 survey questions with a five-point scale 2. Qualitative study: -Focus group study-11 focus group with each consisting of 7-8 students - 3 focus group questions	vSim for Nursing consists of 10 scenarios developed by Laerdal Medical and Wolters Kluwer Health. -Two medical-surgical scenarios were assigned with an average time (15-30min) per scenario	Qualitative data analysis: -MAXQDA - Thematic analysis.	-Qualitative approach results in 6 themes. 1. Improved prioritization 2. Role modeled nursing care 3. Individualized preparedness 4. Engaged critical thinking 5. Anxiety level improved 6. Increased confidence in the lab	Weak

Table 2.9: Characteristics of a study done by Luctkar-Flude et al., (2021)

Author, year, study title Country	Study's Aims/ Objectives	Sample size & participants demographics	Methods of data collection	Intervention/ Exposure	Data analysis	Results	Quality Assessment
Luctkar-Flude et al.,(2021) Designing a Virtual Simulation Game as Presimulation Preparation for a Respiratory Distress Simulation for Senior Nursing Students: Usability, Feasibility, and Perceived Impact on Learning. Place: Canada	To access the usability and viability of virtual simulation games (VSG) as well as to identify the impact on learning	Population: 4-year BNSc Nursing students Sampling technique: For post-usability survey- random sampling Sample size: For the post-usability survey- 92 Samples: For the post-usability survey- 44 in experimental and 46 in the control group Mean age participants: For usability testing- 28.2 years	Mixed method 1.Quantitative approach: Randomized controlled trial VSG development ↓ Usability testing ↓ Post-usability survey ↓ Case study (CS) / VSG 2.Qualitative approach: Usability testing: semi-structured Interview Post usability testing: a qualitative feedback	Experimental group- involves in VSG for the treatment of the patient experiencing respiratory distress from a pulmonary embolus Control Group- involves in the Case study	For quantitative approach: -Descriptive statistics (frequencies and percentages) -Independent t-test -Cronbach's alpha For qualitative approach: -Thematic and narrative analysis	- Qualitative feedback elaborated on 5 major themes. 1. Engagement -Student responded VSG is easy to use, interactive and engaging. 2. Presimulation preparation - More-prepared and less anxious. 3. Rationale - Participants emphasized the helpful aspect of the VSG. 4. Time -Participants suggested VSG could be longer. 5. Learning - Participants responded VSG supported learning and think critically.	Weak

Table 2.10: Characteristics of a study done by Verkuyl et al., (2019)

Author, year, study title Country	Study's Aims/ Objectives	Sample size & participants demographics	Methods of data collection	Intervention/ Exposure	Data analysis	Results	Quality Assessment
Verkuyl et al., (2019) Nursing Students' Perceptions Using an Interactive Digital Simulation Table: A Usability Study Place: Canada	To evaluate the simplicity of use and utility of a newly built interactive digital simulation table to encourage technology adoption before it was integrated into the nursing curriculum	Population: Second-year baccalaureate program nursing students, Sampling technique: Convenience sampling Sample size: 15 Samples: 13 female and 2 male Age of participants: 80% were aged 17-25 years	Usability testing 1. Quantitative approach: -Survey Didactic knowledge on asthma/COPD in class ↓ Body Interact™ (BI) simulation (group of 4-6) ↓ Usability survey -6 Demographic items -17 items with a 5-point Likert scale 2. Qualitative approach: Individual semi-structured interview for 30-60 minutes.	Body Interact™ (BI) is a digital simulator with asthma/chronic obstructive lung disease scenarios.	For quantitative approach: -Descriptive statistics For qualitative approach: -Content analysis	- The qualitative approach results in 5 major themes: 1. Ease of use - Participants noted that BI was simple to use. 2. Experience - Most participants claimed BI was fascinating, realistic, interactive, genuine, engaging, and less stressful than high fidelity patient simulation. 3. Experience in technology - Complaints about the technology were expressed in several ways such as frustration, confusion, unclear. 4. Usefulness - Participants found BI to be more practical, entertaining, promoted critical thinking, and realistic than case studies. 5. Recommendations - Recommended to use BI before laboratory simulations. -Decrease sensitivity of the screen	Strong

2.3.3 Summary of study findings

The findings of this review are summarized in the following analytical themes (Figure 2.2) and a matrix showing the frequency effect size of the five themes (Table 2.11)

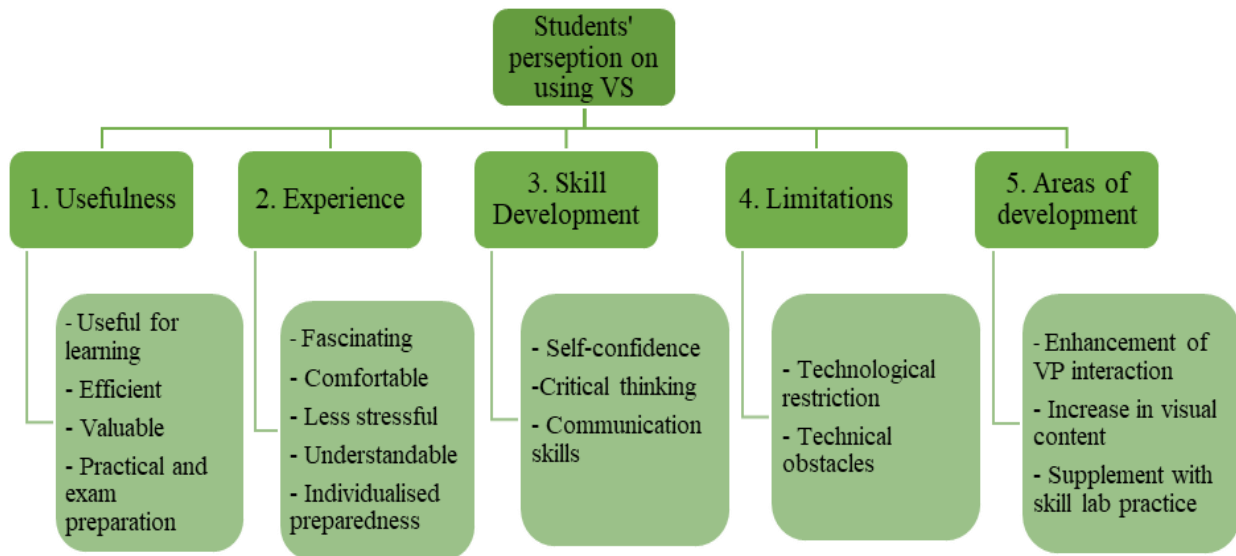


Figure. 2.2 Analytical themes of selected articles

Table 2.11: Matrix showing the frequency effect size of the five themes

Category	Usefulness	Experience	Skill development	Limitation	Areas of Development
Effect size(%)	7 of 7 (100)	6 of 7 (85)	6 of 7 (85)	5 of 7 (71)	6 of 7 (85)
Primary studies					
Carrard et al., 2020	Yes	No	Yes	Yes	Yes
Kim et al., 2021	Yes	Yes	Yes	Yes	Yes
Edeer & Sarikaya, 2018	Yes	Yes	Yes	Yes	Yes
Liaw et al., 2021	Yes	Yes	No		Yes
Donovan et al., 2018	Yes	Yes	Yes	No	No
Luctkar-Flude et al., 2021	Yes	Yes	Yes	No	Yes
Verkuyl et al., 2019	Yes	Yes	Yes	Yes	Yes

1. Usefulness

Seven studies assessed student's perception of VS as a useful learning tool (Carrard et al., 2020; Donovan et al., 2018; Edeer & Sarikaya, 2018; Kim et al., 2021; Liaw et al., 2021; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). Participants praised VS as a stress-free environment where they could organize their thoughts and learn strategies to handle delicate themes (Carrard et al., 2020; Verkuyl et al., 2019). Participants found screen-based computer simulation(SBCS) to be very efficient and valuable in their therapeutic interactions (Edeer & Sarikaya, 2018). Participants also valued re-use and repeated use of VS (Kim et al., 2021) and its use in inter-professional growth (Liaw et al., 2021). In the mixed-method studies, students found VS useful for prioritization and role models in nursing care (Donovan et al., 2018) as well as practical and exam preparation because it was enjoyable and easy to recall (Verkuyl et al., 2019).

2. Experience

Six studies (85%) evaluated the students' experience of VS (Donovan et al., 2018; Edeer & Sarikaya, 2018; Kim et al., 2021; Liaw et al., 2021; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). Most of the participants perceived the visual representations and figures in the VS to be understandable, fascinating and appealing (Edeer & Sarikaya, 2018; Liaw et al., 2021 and Luctkar-Flude et al., 2021). Similarly, participants felt more comfortable, less apprehensive, and completely engaged in their healthcare profession roles (Donovan et al., 2018; Liaw et al., 2021).

3. Skill development

Students' perceptions of VS for skill development were examined in six (85%) studies (Carrard et al., 2020; Donovan et al., 2018; Edeer & Sarikaya, 2018; Kim et al., 2021; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). In heterogeneous studies, participants underlined that VS allowed the growth of various abilities such as communication skills (Carrard et al., 2020; Edeer & Sarikaya, 2018), self-confidence (Donovan et al., 2018; Edeer & Sarikaya, 2018), and critical thinking (Donovan et al., 2018; Luctkar-Flude et al., 2021; Verkuyl et al., 2019).

4. Limitation

Five (71%) studies explored the students' perceptions of the VS's limitations (Carrard et al., 2020; Edeer & Sarikaya, 2018; Kim et al., 2021; Liaw et al., 2021; Verkuyl et al., 2019). Participants felt that VS's influence was restricted to the technological context, without any interactional aspects (Carrard et al., 2020; Verkuyl et al., 2019). Participants encountered the need for a specific language(English) and unfamiliarity with VS as major difficulties in a qualitative study by Kim et al., (2021) while participants in two qualitative studies felt technical obstacles such as a problem with internet access, microphone issues as barriers of VS (Edeer & Sarikaya, 2018; Liaw et al., 2021).

5. Areas of improvement

Participants in six (85%) studies suggested areas of improvement in the VS (Carrard et al., 2020; Edeer & Sarikaya, 2018; Kim et al., 2021; Liaw et al., 2021; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). In a qualitative study by Carrard et al., (2020), medical students emphasized enhancing virtual patient(VP) interaction, quality, variety, and VS scope whereas nursing students provided views that confirmed the level of the achievement and evaluation as areas of improvement in a qualitative study by Kim et al., (2021). The majority of student participants in heterogeneous studies (Edeer & Sarikaya, 2018; Luctkar-Flude et al., 2021; Verkuyl et al., 2019) requested that visual content be increased, the sensitivity of the screen be decreased and believed that VS would not be sufficient for their learning and should be supplemented by skill laboratory practice.

2.4 Discussion

This meta-synthesis of qualitative studies and qualitative approach of mixed-method studies assessed the perceptions and experiences of the participants(nursing, medical and healthcare students) on VS. This review included a total of 7 qualifying studies that met the inclusion and exclusion criteria. According to the review findings, VS is a new pedagogy in nursing education and most evidence indicated that students have a positive perception towards the VS with regards to usefulness, skill development, and valuable experience.

This review demonstrated that participants perceived VS as a beneficial tool for self-learning (Edeer & Sarikaya, 2018), prioritization of care (Donovan et al., 2018), inter-professional growth (Liaw et al., 2021), and improved interaction with patients (Luctkar-Flude et al., 2021) because of repetition, and being more careful with simulation training. Participants in a qualitative study by Carrard et al., (2020) praised VS as a stress-free environment that improved their self-observation and communication skills as well as managed their emotions and sentiments. Hence, they reported that VS can be used as a communication competence exam. Students felt that “vSim for nursing” provided the opportunities to care for the patient alone i.e. individualized preparedness in heterogeneous studies (Donovan et al., 2018; Kim et al., 2021) while Nursing students expressed Body Interact™(BI) offered a secure learning environment where they can learn from their mistakes without any stress (Verkuyl et al., 2019). Furthermore, participants claimed that VS enhanced their self-confidence and critical thinking that supported learning (Donovan et al., 2018; Edeer & Sarikaya, 2018; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). Similarly, Foronda et al., (2020) reported that 60 out of 80 articles revealed enhanced learning outcomes in a systematic review spanning 1996 to 2018. In contrast, participants confronted that VS was initially unfamiliar and distressing, but they rapidly became habituated to it after a few repetitions (Kim et al., 2021). Hence, the provision of clear guidelines and instructions on using VS along with its repeated use aid better learning.

Despite the benefits, the users of VS reported technological limitations due to internet connection (Edeer & Sarikaya, 2018; Liaw et al., 2021) and technical challenges due to unfamiliarity with VS (Carrard et al., 2020; Kim et al., 2021). Although the avatars in VS appeared realistic, participants felt a lack of human element and were disappointed by their inability to deliver empathetic care to patients (Verkuyl et al., 2019). To avoid this frustrating and ineffective learning experience, it is critical to provide adequate technological support and direction to play while using VS. Additionally, participants in different studies (Carrard et al., 2020; Edeer & Sarikaya, 2018; Kim et al., 2021; Liaw et al., 2021; Luctkar-Flude et al., 2021; Verkuyl et al., 2019) suggested to increase the visual material and interaction in VS, provision of immediate feedback and combined with skill laboratory practice to improve knowledge and learning. However, none of the studies looked at how participants felt about VS in terms of decision-making skills and its comparison to CS. Hence, the current qualitative study will focus on students’ opinions of VS for decision-making and its comparison to CS.

2.5 Limitation of review

This review was constrained in several ways. From the beginning, it was evident that limited research has been conducted on the VS from the participant's perspective. The addition of search phrases like 'mobile games', 'videogames', and 'screened-based learning' could have helped to broaden the results. However, these terminologies were not utilized as the review's purpose was to concentrate on the students' perceptions of VS. The qualitative appraisal using CASP checklist (Table. 2.3) revealed that most of the papers included were of poor quality with only a few of moderate grade. Almost all of the studies have moderate to high risk of social desirability bias because of sampling techniques where the samples were self-reporting and voluntarily participating, limiting the possibilities of participation (Etikan, 2016). Furthermore, the majority of the research relied on focus group discussions, which may be limited in scope due to group participation being hindered by others and in-depth (Guest et al., 2017). The discussion inside every focus group is influenced by the interviewers' ability, participants' personalities, and emotions related to the topic (Kidd & Parshall, 2000). Moreover, it is difficult to make valid inferences from this review given the dynamic nature of the subjects, the use of numerous VS, and relatively small sample sizes.

2.6 Identification of gaps in the literature

Even though research on VS is increasing by the day, this review showed a paucity of literature and high-quality research concentrating on the healthcare students' perspectives on VS. While few studies have gathered participants' feedback on the influence of VS on usefulness, learning, knowledge, and self-confidence, the researcher was unable to locate any relevant studies seeking participants' feedback on decision-making skills. Similarly, a researcher couldn't find any articles comparing students' experiences with VS to CS. Hence, the current study will examine nursing students' perception of VS in terms of impact, confidence, decision-making skills, and comparison to CS to fill a gap in the existing literature. To the researcher's knowledge, no research on the nursing students' perceptions of VS has been undertaken in the UK. Hence, a high-quality study will be performed to retrieve in-depth information through one-to-one interviews, thereby expanding the body of knowledge and literature in the field of VS and students' reactions to VS.

2.7 Conclusion

VS is a new pedagogy in the sphere of nursing education. For this reason, there has been limited research conducted on the effectiveness of the VS in the teaching-learning process for nursing students and their perceptions of its use. The meta-synthesis was conducted to integrate the qualitative studies and qualitative approach of mixed-method studies, with the majority of evidence indicating that VS is a beneficial, stress-free, and effective learning tool. Students described VS as understandable, engaging, and enticing, as it helped them build self-confidence and knowledge while minimizing anxiety. They also identified technical concerns with VS and offered suggestions for overcoming such obstacles and enhancing the software's usage. As far as the author is aware there is a paucity of literature investigating students' perceptions of the influence of VS on decision-making skills and comparing their experiences of VS to CS. Hence, this qualitative study will be conducted to fill the gap in the literature and expand the body of knowledge in the field of VS as well as students' experiences in VS.

Chapter 3 - Research methodology

This research study is a part of a large random control trial(RCT) that compared VS to CS in the context of confidence, anxiety, and knowledge acquisition. This chapter explains the research methodology and study process. The discussion begins with a description of qualitative research design including an explanation of rationale, a portrayal of the population, a sampling technique, and a study sample. Similarly, this chapter extends to the details of a study setting, data collection, and data analysis process. Furthermore, it also covers ethical considerations and the steps required to ensure credibility, dependability, confirmability, and transferability.

3.1 Research Design

A qualitative descriptive design was used for this study as it aimed to explore the nursing students' experiences with VS and the research question positioned the participants at the focus of the study. This design offers simple accounts of people's views and perceptions of a specific phenomenon (Doyle et al., 2020), acknowledges the subjective aspect of the situation, and discusses the results in a form that matches the terms used in the research question (Bradshaw et al., 2017).

3.2 Setting of the study

The study was conducted in Edinburgh Napier University, Scotland, United Kingdom. Edinburgh Napier University is one of the prestigious Scottish higher educational institutions across various disciplines.

3.3 Consent process

Written invitations were sent to all the eligible participants via their Bachelor of Nursing program visual learning platform and distribution of flyers. Additionally, the researchers, with the assistance of the instructors, delivered a verbal invitation. At this time, students were

informed more fully of the study through participant information sheet(Appendix 3) and privacy statement(Appendix 4). They were also reassured that it wasn't linked to their academic work, their participation was voluntary and, if they wish, they were free to withdraw consent at any moment during the study. Once they consented to participate, they were emailed a link to an online consent form and a workbook with background theory on the care of a person presenting with COVID-19 pneumonia. After they participated in VS, the researcher invited all the participants to take part in the qualitative interview. Once agreed, they were asked to provide verbal consent to participate in a one-to-one interview.

3.4 Recruitment of participants

The recruitment and data collection phase progressed in September, October, and November 2021. The participants were encouraged to choose the date and time for the data collection sessions convenient for them. When they agreed to participate in the qualitative phase, their contact details were retained and a Microsoft teams link was sent on the agreed-upon date and time for the one-to-one interview.

3.5 Participants

The study's participants were the second-and third-year Bachelor of Nursing students in ENU. These students were selected as study participants because they are the future nurses who will provide nursing care to a patient suspected of COVID-19 and participated in the game. Hence, they were deemed capable of providing their perceptions and experiences with the game. The total eligible population for the study meeting the inclusion and exclusion criteria (shown in Table 3.1) is 34.

Table 3.1: Inclusion and exclusion criteria for participants

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> - Second-year Bachelor of Nursing students in ENU. - Third-year Bachelor of Nursing students in ENU - Students that got an opportunity to participate in the VS for a quantitative study. - Willing to participate in the study 	<ul style="list-style-type: none"> - First-year Bachelor of Nursing students in ENU. - Students involved in the master degree in Nursing in ENU - Students that got an opportunity to take part in clinical simulation in the quantitative study - Nursing students from other universities

3.6 Sampling

The sampling strategy used in a study must complement the research concept and research question. Convenience sampling was used because it enables the researcher to approach and choose the participants who are easily and efficiently available at a given time (Bradshaw et al., 2017), willing to participate, and is affordable (Etikan, 2016).

3.7 Size of sample

Although qualitative descriptive studies mostly conceive a small number of samples due to the close contact with participants (Bradshaw et al., 2017), researchers must ensure that they have sufficient data to achieve the study's objectives (Doyle et al., 2020) and the findings should not be assumed generalizable (Bradshaw et al., 2017). However, it may be problematic to define the sample size priorly in an exploratory study as the identification of key themes can't be done in advance (Clark & Clark, 2006). Hence, the gold standard for determining the sample size i.e. data saturation was utilized to nominate the number of samples. Data saturation is the ultimate point reached when there is sufficient data to present in the study and no longer possible to gather fresh information and further coding (Fusch & Matriculation Number

Ness, 2015).

3.8 Ethical consideration

Ethical clearance and approval were obtained from the institutional review board of the School of Health and Social Care, ENU. Then, a letter of cooperation was given to conduct the study. Before data collection, the study's aim was explained to respondents and they gave their consent to participate in the study. Participants signed a consent form as well as provided verbal consent before enrolment in the online interview. The confidentiality of the study participants has been kept at each level of the response.

3.9 Data collection procedure

A qualitative exploration of participants' perceptions of the VS was carried out. It explored their views of the acceptability and impact of the COVID-19 scenario game had on their knowledge and skills when confronted with a person with suspected COVID-19 who is clinically deteriorating. An online one-to-one interview using a pre-determined topic guide that lasts no more than 30 minutes was preferred by the researcher since it provides better accessibility, lower expenses, and is convenient for participants (Ryan et al., 2009). All the participants who had been involved in the game were invited to the interview. Before the interview, the demographics of the participants were collected. A semi-structured interviewer-administered questionnaire(Appendix-6) was prepared to conduct in-depth interviews with the participants through a digital platform and also used to follow new emerging ideas and refine subsequent interviews. The data were gathered and transcribed using university-approved online platforms i.e. Microsoft teams. The interviews were conducted by one member of the research team all of whom are qualified health care professionals. The data collection was halted once the data saturation was reached.

Reflexivity

This study depended on the data collected through interviews which may have several drawbacks. However, during the qualitative interview, semi-structured questionnaires were utilized in data collection to avoid the introduction of the interviewer's opinion in the data.

To eliminate bias, the interviews were performed and analyzed by a member of the research team who was not affiliated with the educational program of the participants as well as not engaged in the formulation of the game. However, unconscious bias can arise since the researcher unknowingly acts in a way that leads to a specific research result. Similarly, there may be some limitations in asking effective probing questions to obtain wider and richer conceptual information as the interviewer was a post-graduate student doing her first one-to-one interview. Whilst this feature of the interviewer may be beneficial in understanding and exploring in-depth information from the student participants for qualitative study.

3.10 Data storage and disposal

Data storage and disposal were done according to the data management plan (Appendix 5). Following the interview, the audio recordings and their transcriptions were forwarded to the university's secure web server for storage and were erased from the recording device within a week of the interview. The audio recordings and transcriptions were subsequently anonymized and were stored in the electronic textual format using MS Word and NVIVO software. Participants' contact information was separated from research data and securely stored until the end of the research project. Only the members of the research team had access to the research data. At the end of the research, electronic data will be kept securely for ten years and destroyed as per ENU guidance for the safe disposal of confidential waste.

3.11 Data analysis

Thematic data analysis was used in this study because it aids in thorough identification, organization, and understanding into meaningful themes over a large dataset (Braun & Clarke, 2012). It is also simple to use and adaptable. Thematic analysis can be inductive, deductive, and abductive (de Farias et al., 2020). However, abductive thematic analysis using the NVivo software is an appropriate approach for this data analysis.

The abductive analysis is an active and interpretive process that is aimed at producing new hypotheses and theories based on surprising research evidence (Timmermans & Tavory, 2012). It can explore the issues that may arise during thought development and reasoning in a

qualitative study (Lipscomb, 2012). Instead of discarding all previous theoretical notions throughout research, it reinforces the researcher to approach the study with a deeper and wider theoretical framework (Timmermans & Tavory, 2012).

In an early stage of abduction, hypotheses are formed which are then explained through deduction and proven by induction (Råholm, 2010). It is beneficial since it assists the researcher with posing some fascinating problems and questions, which are vital for the study (Lipscomb, 2012). Hence, data analysis began concurrently with the data collection and the necessary steps of the process were reviewed before proceeding with additional analysis to confirm that the emerging themes were based on the original data. The data analysis in this study follows the five steps of abductive thematic network analysis(ATNA) (Zarkada et al., 2017):

Step 1: Coding data

- Coding is a critical component of qualitative data analysis as it allows researchers to access data to test hypotheses and draw conclusions (Zarkada et al., 2017). The codes in this study were derived from the semi-structured questionnaire guide used in the interview. The derived codes were confidence, knowledge, decision making, usability, comparison, and areas of improvement. The NVivo program was used to code the data systematically. The transcribed data was read and re-read actively and the audiotapes were also carefully and repeatedly listened to get the genuine meaning and pattern. Along with reading, the researcher began taking notes and coding data. When all of the data has been thoroughly coded and relevant data for each code has been gathered, this step of the process is completed. However, the researcher can return and adjust the codes during the analysis process.

Step 2: Identifying themes

- This phase entails examining the coded data and the fundamental process of creating themes and subthemes which involves collapsing or grouping codes that appear to share certain uniting characteristics and meaning. The four overarching themes and their sub-themes were identified and thoroughly analyzed (Table 4.2). Each theme was defined and refined along with its specific elements.

Step 3: Creating and Describing linkages

- The researcher applies adductive reasoning to identify and characterize the connections between the themes at this step. The focus in this step is to explore the interaction among the themes to form the network that can be used to broaden the phenomena and answer the research questions.

Step 4: Developing a plausible model

- The identified themes were compared to the coded data and complete data set. Another team member then double-checked the themes and sub-themes. Finally, the student researcher and advisor worked together to develop four distinct themes. Themes and sub-themes within a network were organized into a thematic map (Figure.4.1).

Step 5: Assessing the developed model

- Since the model is a novice, the student researcher and advisor evaluated its explanatory quality. It is judged on its theoretical elegance, coherence, and scientific merits. After themes and sub-themes were approved, the final analysis and writing were completed by the researcher which is explained in the next chapter.

Rigor

To prove the accuracy of the information, the researcher was concerned with the aspects of trustworthiness. These aspects consist of credibility, dependability, confirmability, and transferability (Bradshaw et al., 2017). Before the interview, each participant was asked for written and verbal consent. The data collected were kept confidential and assigned a distinct code for instance: QI-0X. To establish trustworthiness and ensure that all participants were asked the same questions, the semi-structured questionnaire guide was utilized.

To achieve credibility, the researcher created a rapport with the participants before the interview and conveyed empathy during the interview. The participants were given enough time to react and were engaged for an extended period. Two members of the research team thoroughly reviewed the transcripts and double-checked them with the participants to ensure data dependability over time and conditions. Subsequently, actual statements from

participants were included to establish confirmability, demonstrating that the findings reflected the data collected, and were not skewed by the researcher. Transferability implies the extent to which findings can be transferred or applied to different situations. The researcher recruited participants through convenience sampling for one-to-one interviews from a single institution which may have influenced the generalizability of the findings. Moreover, the one-to-one interviews provided a greater depth of information than focus group discussion without any outer influences (Guest et al., 2017). Hence, the result of this qualitative study might be transferrable to other large-scale studies as well as studies in middle- and lower-income nations.

3.12 Dissemination of findings

The result of the study will be submitted to the School of Health and Social Care, ENU. The research data will be deposited into a university repository, where they can be cited using a persistent identifier and will remain accessible for at least ten years. Moreover, the study will be published in journals such as SAGE Journals, Nursing Education Today, and presented at educational conferences.

Chapter 4 - Research findings

This chapter presents the findings from data analysis conducted as a part of the qualitative approach that addresses the research question.

4.1 Demographic findings of the participants

Out of 34 eligible participants in the COVID-19 scenario game, 17 nursing students participated in a one-to-one interview for this study. There were 82.35% (14) female participants, 11.76% (2) male participants, and 5.89%(1) others. 35% (6) were second-year nursing students and 65% (11) were third-year nursing students. All participants were full-time students. The average age of the participants involved was 31.64 years, with the youngest being 21 and the oldest being 48 years old. The demographics of the participants are shown below (Table 4.1). Each interview lasted between 15-20 minutes.

Table 4.1: Demographics of the participants

Demographics		N
Gender	Male	2
	Female	15
Year of study	2 nd year	6
	3 rd year	11
Age of students	Average	31.64 years
	Youngest	21 years
	Oldest	48 years
Enrolment	Full-time	17
	Part-time	0

4.2 Thematic findings of the study

The common themes that emerged from the abductive data analysis were posed concerning the open-ended questions. After data analysis, four primary themes were emerged: Confidence, Applicability, Comparison with a CS, and Usability and areas of improvement, as shown in the thematic map (Figure 4.1).

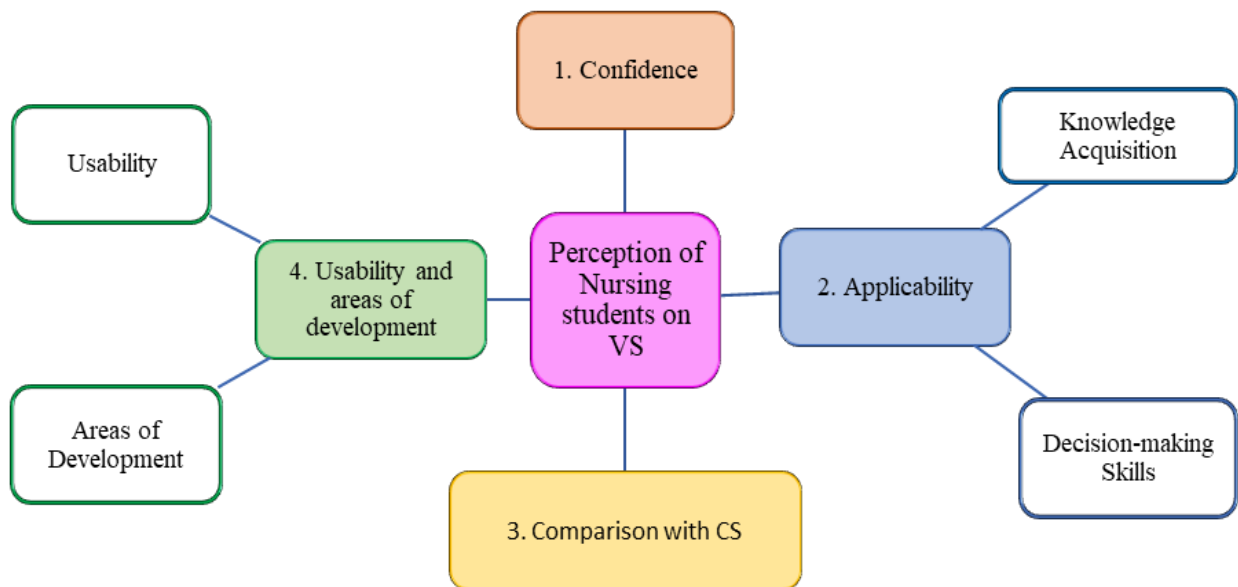


Figure 4.1:Thematic map of the qualitative data analysis

Table 4.2 explained the derived themes and sub-themes in depth. The findings for each theme and the transcripts of the participants who agreed with the themes were presented below:

Table 4.2: |Explanation of the primary themes and sub-themes of the study

S.N	Themes	Sub-themes	Explanation	Topic guide question
1	Confidence		Confidence is defined as the feeling of self-assurance that arises from one's abilities and skills. It is measured by analyzing the self-assurance and belief that the participant has after playing the COVID-19 scenario game.	Having accessed the resource what impact do you think this had on your confidence to assess and treat a person who was clinically deteriorating with suspected COVID-19?
2	Applicability	Knowledge Acquisition	Applicability is defined as the quality of being an appropriate or useful method for nursing education. Two sub-themes were identified in this theme: 1. Knowledge acquisition and Decision-making skills.	What impact do you think the resource has had on knowledge and decision-making skills?
		Decision-making skills		
3	Comparison with a clinical simulation		Comparison is defined as the trait of being similar or identical. The applicability and acceptability of the COVID-19 scenario game and clinical simulation are compared and evaluated.	In your experience how does this compare to clinical simulation?
4	Usability and areas of improvement	Usability	Usability is defined as the degree to which the VS is suitable for usage. It is determined by examining the utility of the COVID-19 scenario game.	How did you find the usability of the resource?
		Areas for Improvement	The areas of improvement are defined as the modifications and changes that need to be addressed in the VS to make it better and more efficient as indicated by the interviewee.	Can you consider any areas for development or improvement with the resource?

4.2.1 Theme 1: Confidence

Confidence is defined as the feeling of self-assurance that arises from one’s abilities and skills. It is measured by analyzing the participant’s self-assurance and belief after playing the COVID-19 scenario game. During the quantitative phase of the RCT, the confidence and anxiety of the participants were measured by using the validated tool: NASC-CDM (White, 2014). Hence, this phase explored the participants’ perception of whether playing the game enhanced their confidence in managing a person clinically deteriorating with suspected COVID-19. The overview of this major theme from the interview is presented in table 4.3.

Table 4.3: Summary of one-to-one interview major theme: Confidence

Students	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17
Enhanced Confidence level	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
No change in confidence level				✓													
Decrease in confidence level											✓					✓	
Decrease in anxiety and apprehensive			✓					✓						✓	✓		

The majority of students (14 out of 17) perceived an increase in confidence. Their confidence level has improved along with the understanding of the clinical scenario and its management, preparing them for what to expect during a real-life interaction in their clinical practice. The following narrative data supported major theme 1 of the interview.

I've gained confidence as I have a greater understanding of the signs and symptoms of someone who comes in with COVID-19 into hospital settings, I feel I know how to treat and manage a person who has COVID-19. (S1, T1)

I'm fully confident. I wanna make a clinical decision and how I'm going to treat the patient really-really quick because this need was like a life-threatening situation...(S2, T1)

I felt more confident than before ..if it was like in one to five scale, I'd put it like a three. If it had been a one before to 3 now. (S7, T1, T2)

After playing the game, few participants reported feeling more confident, which resulted in a decrease in anxiety, apprehension, and mistakes, as well as making them more relaxed.

...So if I will be in this situation in real life I will be a little bit calmer and would say gain the confidence to treat the patient. (S3, T2)

I feel like often you go in and you're not sure and you're nervous. But when you have this information behind you, it might come like improve your confidence. (S8, T3)

I think it would just mean like .. fewer mistakes or such, and it's more confidence ..when I'm in the clinical area. (S15, T2)

Conversely, a small proportion of participants reported a negative impact on their confidence. Two students expressed a drop in confidence due to being unaware of the situation and scenario, while one reported no change in confidence. Their narrative data are as follows:

In my personal experience, I don't think it gave me more confidence in my practical experience. (S4, T1)

I think it damaged my confidence. (S11, T1)

This suggests that the simulation game had a positive impact on the confidence which reflects the quantitative results where an overall increase in confidence was reported by those playing the digital scenario.

4.2.2. Theme 2: Applicability

Applicability is defined as the quality of being an appropriate or useful method for nursing education. Two sub-themes were identified in this theme: 1. Knowledge acquisition and 2.

Decision-making skills. The participants’ perception of knowledge acquisition and decision-making skills after exposure to VS is discussed below.

4.2.2.a Knowledge acquisition

The purpose of the question was to understand how participants viewed the VS as a tool for gaining and improving knowledge. The focus was to find whether or not participants appreciated using VS to improve their knowledge and learning. After playing the game, the responses provided in the interview serve to determine the students’ gain in knowledge. The summary of this sub-theme from the interview is presented in table 4.4.

Table 4.4: Summary of one-to-one interview sub-theme 1: Knowledge acquisition

Students	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17
Improve knowledge acquisition	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Easy learning				✓	✓							✓			✓		✓
Reinforcement and retention of Knowledge					✓		✓							✓			
No change in knowledge				✓							✓						

Most of the nursing students (15 out of 17) perceived that their knowledge had increased after playing the game. They reported that the game assisted them to uncover knowledge gaps regarding the management of COVID-19 pneumonia and helped them fill those gaps. The participants stated that they learned the clinical aspect of COVID-19 pneumonia as well as how to investigate and treat it. They also claimed that the game taught them new facts about oxygen therapy, fluid and medical management, all of which are crucial and potentially life-saving interventions.

Yeah, help with the background knowledge for COVID-19 patients.. (S2, T1)

It's made me aware of what you would do in the relation to pneumonia. UM, and the fact that if you've got someone who's not breathing right, and they're struggling with their accessory muscles. You'd put them straight onto a non-rebreather (S5, T1)

Like it goes through a lot of things, even medications that which fluid you use.

And what's important like vital signs and blood investigation of the patient? So, it's a good way of teaching. (S15, T1)

After playing the game, four participants found the teaching-learning process using the VS to be simple and easy. Moreover, they mentioned that they learned the step-by-step process for accessing and managing COVID-19 suspects.

So it's a good way of teaching. And firstly, and I think just 'cause it's a simulation. It goes into your head more easily compared to if you were just to study the book. (S15, T2)

This resource taught me about the, uh procedures. For example, what do I need to do step by step,.. once the patient is admitted to the hospital. (S17, T2)

Additionally, the participants stated that exposure to the game assisted them to reinforce their knowledge. Since the game helped them in putting theoretical knowledge into practice, they believe that the learning regarding the clinical aspect and managing a patient with suspected COVID-19 will be retained and used in the future in clinical practice.

...so I did learn a lot from that scenario because at some of the questions I didn't know how to answer. And then once I've gone through it I knew. (S5, T1)

Clicking on the different tabs and thinking and seeing the different options of the things I could do. So that helped me to develop my knowledge and I feel like, uh, maybe I'll retain the knowledge better. (S7, T1)

Nevertheless, only two participants expressed that the game didn't influence their knowledge acquisition. Their narrations are as follows:

I don't think it's sort of... knowledge has sort of grown much for that. The simulation didn't provide me with any knowledge. (S4, T1)

It didn't affect my knowledge either positively or negatively. (S11, T1)

4.2.2.b Decision-making skills

The purpose of the question was to identify how participants viewed the VS as a tool for enhancing decision-making skills. The goal was to explore how or if the participants valued utilizing VS to strengthen their decision-making abilities. The interview replies were used to assess the nursing students' perspectives in decision-making skills after playing the games. The summary of this sub-theme from the interview is presented in table 4.5.

Table 4.5: Summary of one-to-one interview sub-theme 2: Decision-making skills

Students	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17
Improved decision-making skills	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓
Retention of decision-making skills			✓				✓										
No change in decision-making skills									✓				✓				
The negative impact on decision-making skill											✓						

Most of the participants (14 out of 17) claimed enhancement of their ability to make quick decisions. They further stated that the game enabled them to exercise independent decision-making. They admitted that they were unable to apply their decision-making skills in clinical practice and will instead follow the instructions of their teachers and senior nurses. However, the game offered them a safe and realistic environment where they can practice their skills without fear of mistakes and consequences. The participants mentioned that the immediate feedback in the game had also benefitted in fast decision-making skills.

So in this simulation, it's you who's the one who's doing it, but within the practice, you don't get that authority. (S5, T2)

...if I clicked like the wrong decision making the wrong decision ..the computer would say, oh, I think you should try again. Which is good because if I had just written that down I wouldn't have known that I got it wrong. (S12, T1)

..but it kind of felt with the beeping in the background you felt like you had to make a decision quickly, so uh, it's kind of similar. That is, you know doing that kinda improves your decision-making skills. (S15, T2)

Similarly, participants reported that they learned the crucial considerations to keep in mind during the decision-making process after playing this game. They also expressed that seeing a good picture of the clinical area and decision-making in the same scenario impressed them and helped them to retain their decision-making skills for future reference.

You know, that gives me like little bit highlight in my head what we can do if I'll have any.. If I would be with difficult patients. (S3, T2)

For me when I'm making clinical decisions I rather view the patient as like a problem with their respiratory system. I, as a person as a whole, so I'm thinking a lot about his circulation, this and that. (S7, T1)

Conversely, a small number of students were dissatisfied with the game's impact on their decision-making abilities. Two participants expressed that their decision-making abilities had not changed. Due to a lack of confidence, they were unable to make decisions and must rely on senior nurses and instructors. They communicate their feelings in the following manner:

I wouldn't say that I'm comfortable deciding in a real situation after this knowledge has improved. (S9, T2)

For making decisions, I don't think I'm that confident in making decisions myself, yet I would still go to whoever was above me. (S13, T1)

However, one participants' decision-making skills were severely harmed after playing the COVID-19 scenario game.

..Because it damaged my confidence, I'd say it negatively impacted my decision-making skills. (S11, T1)

4.2.3 Theme 3: Comparison with a clinical simulation

Comparison is defined as the trait of being similar or identical. The applicability and acceptability of the VS were compared and evaluated against CS. Since VS is a novel pedagogy, it is compared to CS to determine the participants' preferences. The VS was compared to CS in terms of efficiency, efficacy, informative criteria, and if it could replace CS. The summary of this major theme from the interview was presented in table 4.6.

Table 4.6: Summary of one-to-one interview major theme: Comparison with a CS

Students	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
Efficacy and efficiency					✓				✓		✓		✓		✓
More informative												✓			
Suitable replacement of clinical simulation									✓						
Complements clinical simulation				✓		✓		✓	✓						
Preferences (VS) or (CS)	CS	CS	CS			CS	CS	Both	VS	CS		VS	VS	CS	

Both clinical and virtual simulations have pros and cons. However, participants stated that the game was more efficient and effective than CS. They emphasized that VS allowed them to obtain the same information more readily and faster than CS. Additionally, they claimed that the game is more beneficial and less stressful as it can be accessed at any time and from any location.

Well, I think it's less stressful doing it digital than the clinical skills. (S6, T1)

I mean, that's the obvious advantage of a digital simulation that you can access it and use it whenever you want. (S11, T4)

It's a much sort of easier and quicker process than having to sort of coming into university for the day or a few hours sort of thing or whatever. Uh, and I probably have retained information just the same. (S14, T1)

Likewise, one participant found the game to be more informative than CS. He stated that

some practical knowledge is difficult to acquire through CS, but is readily available in a VS.

Well, it's on a mannequin you can't hear the sounds of the lungs. And you'll hear on the ..the simulation, the difference and normal lung sounds and abnormal. (S13, T1)

I think it was good having in the normal ranges next to the results 'cause I wouldn't have known what was a normal result. (S13, T2)

Moreover, one participant thought that the game was beneficial and nearly identical to the real-life scenario and that the CS could be replaced by the VS.

And potentially a suitable replacement. Certainly, you've got more time to do it, and I think the way it was structured you know, it's like you're in an actual room with people and the results, and it's fairly similar to what it would be like in real life in a way. (S10, T3)

However, a small percentage of participants (4 out of 17) perceived that VS complements CS. They stated that the VS provided them a better concept of the clinical scenario and what to expect once they started clinical practice.

It's good pre-practice for going out before you go out into a placement. (S5, T1)

I think something like that would be really useful to complete before you go in-person skills, you know, give you a background. (S7, T2)

Participants also discussed the benefits and drawbacks of virtual and clinical simulations. They made their preferences based on the pros and cons of each option. Seven participants favored the CS, stating that they learned best by doing, whereas 3 participants preferred VS, rationalizing it as a safe and realistic alternative. Additionally, only one participant appreciated both simulations for learning and understanding.

Well, I probably prefer the clinical simulation ... (S15, T1)

I feel that ..in some ways, it's a safer environment because you know, ..you're working on it by yourself. (S10, T1)

.. I know it's not the best answer, but you'd want one or another but for me. I'd say both would be good to have. (S9, T4)

4.3.4 Theme 4: Usability and areas of improvement

The usability of VS is a measure of how well a user can utilize it to gain knowledge and understanding efficiently and effectively. Additionally, a thorough examination and measurement of the usefulness of VS aid in identifying any areas for improvement to make it more valuable and understandable.

4.3.4.a Usability

Usability of VS is defined as the degree to which the VS is suitable for usage. It is determined by examining the utility of VS. The prompt question was asked for analyzing the usefulness of VS . The summary of this sub-theme from the interview was presented in table 4.7.

Table 4.7: Summary of one-to-one interview sub-theme: Usability

Students	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17
User Friendly	✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	
Easy to understand						✓		✓		✓		✓		✓	✓	✓	
Enjoy using VS		✓	✓		✓					✓					✓		
Not User-friendly							✓				✓						✓

According to the majority of players (12 out of 17), the game was user-friendly. They said that its simplicity and ease to understand enable them to navigate through the entire game.

The instructions in the game were simple and clear enough that they could play the game smoothly, without difficulty. They also viewed it as a valuable and beneficial instrument for expanding their knowledge and comprehension.

Found it pretty easy to go through once it was explained how to use it (S1, T1)

I thought the usability was good because I'm quite good at computers and I was able to navigate it around. (S12, T3)

*I found it straightforward to use, even like using this space bar on the next thing..
..It's very user-friendly. (S16, T2)*

Furthermore, seven participants found the game to be simple to learn. They said that the game was interactive, participative, and self-explanatory. They also mentioned that it provided self-judgment, which made it more effective.

I found that a really good aspect because they interact in part like I had to participate. (S12, T1)

I thought it was all pretty user-friendly and quite self-explanatory... (S14, T3)

Aside from its interactivity, explanatory nature, and convenience, few participants (5 out of 17) found it engaging and entertaining. They said the game was so intense that they were completely immersed in it as if they were in a real-life situation.

... yeah, I enjoyed using it, I thought was a pretty good program and the way it was designed. (S10, T7)

I did enjoy this actually and I kind of, you know, when you're in it. Yeah, it kind of forgets everything around you. (S15, T3)

However, three participants complained that the game was difficult to operate. They also expressed dissatisfaction with their inability to provide empathetic care in a clinical context. These participants found the game unsatisfying, claiming it was too complicated and

ambiguous.

I found it quite confusing. I wasn't quite sure what it wanted me to do sometimes? (S4, T2)

For, because it was a simulation. It didn't like seeing with a given like compassionate care and stuff like that... (S7, T1)

...because that damaged my confidence. I feel warier about now going into placement and providing care to people. (S11, T1)

4.3.4.b Areas of improvement

- The areas of improvement are defined as the modifications and changes that need to be addressed in the VS to make it better and efficient as indicated by the interviewee. The prompt questionnaire asked to analyze the areas of improvement. The summary of this sub-theme from the interview was presented in table 4.8.

Table 4.8: Summary of one-to-one interview sub-theme: Areas of improvement

Students	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17
Additional instruction to navigate				✓				✓	✓					✓			✓
Additional information for knowledge				✓			✓			✓	✓		✓				
Technical improvement		✓								✓					✓		
Separation of questionnaire																✓	

Following their exposure to the game, participants identified areas where they felt the game could be improved. Five participants advised that further instruction be added to aid with game navigation. They claimed that the clear navigational instructions will make the game more user-friendly, improving its usefulness.

I just sort of said like clearer onscreen instruction may be helpful... (S4, T2)

Maybe menus clearer to know where you should go because it's easy enough... (S9, T2)

Similarly, five participants reported a lack of information for knowledge enhancement. Hence, they recommended that the amount of information and rationale relevant to knowledge and understanding be increased.

And so yeah, maybe having.. that as well as you know, like the normal ranges were, therefore, the other one would be quite useful. (S10, T3)

Either one you pick something and get it right, or picks, and when you get it wrong you get more explanation as to why they were right or wrong. (S11, T1)

Few players believed the game had technical flaws such as a lack of engagement with the avatars and oversensitivity of cursor. Hence, they proposed increasing interaction with the avatars to make them more realistic and successful. They also advocated that the oversensitivity of the cursor be managed or that an alternative navigation method be set up.

.. Patient involvement.. And I know the patient is in shortness of breath. Not talking so much but ..any Interaction with the patient. (S2, T1)

Uh, that instead of them kind of talking about different things. Maybe there could be a dialogue option where you speak to them and you tell them what you think and they might answer it compared to saying something. (S15, T2)

Listening to the patients' chest. Uhm, it was a bit difficult because the mouse would move so quickly and for the different to try and focus on the different sections. So perhaps something. You know slower mouse sensitivity or the option of putting it up or down. (S10, T2)

Likewise, the placement of the questionnaires in the game caused participants trouble and confusion. As a result, they proposed splitting the question into segments or the application of

instructional video for easier comprehension and understanding.

Like I picked the right in the correct first answer, which made the second and third answer. .made me skip later so it maybe it might be better if the questions were separate. (S16, T1)

(Note: S- Student, T- Transcript)

To conclude, nursing students perceived VS as an applicable tool for enhancing their confidence, knowledge, and decision-making skills. They claimed that VS can both complement and replace the CS where presential simulation isn't possible. Additionally, participants valued technical advancement to improve the quality of the game. Subsequently, these results will be analyzed and discussed in the next chapter.

Chapter 5 - Discussion and analysis of findings

The discussion of various components of the study will be covered in this section. The discussion begins with a statement of the main objective of the study along with a brief explanation of its findings. Moreover, it will determine the extent to which the findings addressed the study's aim. Subsequently, the thematic findings will be explained and compared to past research findings. Furthermore, the strengths and limitations of the study will be analyzed. Finally, knowledge gaps will be identified and recommended for future research.

5.1 Objectives of the study

This study sought to explore perceptions of VS with nursing students and its impacts on confidence, knowledge, and decision-making skills. VS is a relatively new idea that has been proved to improve students' learning outcomes in nursing education (Foronda et al., 2020). Additionally, it is earning increased recognition as an educational medium due to the influence of the COVID-19 pandemic (Wiese et al., 2021). Despite its prevalence in nursing education, an extensive literature review revealed a scarcity of studies focussing on students' perception and opinion on VS. Even though some studies have gathered participants' feedback on the influence of VS on usefulness, learning, and confidence, a researcher was unable to find a study to access the students' opinion of VS on decision-making skills. Acknowledging the paucity of literature comparing virtual and clinical simulation, we explored this key concept with participants.

5.2 Key Findings of the study

In the current study, the majority of participants noted an increase in confidence, as well as a reduction in anxiety and apprehension. Similarly, the students highlighted the game's usefulness in terms of knowledge reinforcement and retention as well as improved decision-making skills. Furthermore, they praised the usability of the VS describing it as clear, user-friendly, interactive, and self-explanatory. Despite its benefits, a few participants experienced confusion and proposed improving navigational instructions, additional knowledge, and

active participation of users and avatars in the game. While comparing VS to CS, participants appreciated the game's easy accessibility and efficiency including its ability to complement the VS. Hence, the current study resulted in positive participants' perceptions of the usability and applicability of the VS.

5.3 Discussion of findings of the current study concerning available literature

In this part, the findings of the current study are discussed and compared with existing studies. These findings are addressed in more detail as below.

5.3.1 Enhancement of confidence level

The majority of the nursing students who took part in the current study stated that the exposure to the COVID-19 scenario game enhanced their confidence to understand the clinical scenario and its management while lowering their anxiety and making fewer mistakes in real-life situations. This result is supported by various studies (Donovan et al., 2018; Edeer & Sarikaya's 2018; Kim et al., 2021). During the COVID-19 pandemic in South Korea, Kim et al., (2021) performed a qualitative study to understand prelicensure nursing students' perceptions and experiences of utilizing VS(vSim for nursing) as a replacement to clinical simulation (n=20), where participants experienced that VS was beneficial to gain the confidence and ability. They also stated that they might use VS to self-evaluate and enhance their abilities regularly. Likewise, a mixed-method study by Donovan et al., (2018) was conducted to analyze nursing students' perceptions and experiences of the computer-based simulation used before participating in the clinical simulation in the USA (n=82), where participants felt more confident, much calmer, and less anxious. Similarly, participants in the current study perceived an increase in confidence after exposure to VS. This impression is supported by the evidence of a quantitative study that found an increase in self-confidence score among the VS group (pre-test- 3.6, post-test- 3.8, MD= -0.28). However, a few participants reported a decrease in confidence due to unfamiliarity with VS. Hence, preparatory practice work or instructional videos might help in its awareness.

5.3.2 Improvement in knowledge acquisition

In terms of knowledge acquisition, most of the nursing students involved in this study gained

knowledge regarding the clinical aspect and management of COVID-19-related pneumonia which was the primary aim of developing the game. They also reported that the game taught them emergency medical management which was a critical and possibly life-saving intervention. These findings are consistent with the results of different studies (Donovan et al., 2018; Edeer & Sarikaya, 2018). They also highlighted that VS allowed them to care for the patients on their own and simultaneously enhanced their learning and critical thinking abilities. Luctkar-Flude et al., (2021) ran a usability survey to determine the usability and viability of virtual simulation games(VSG) and their influence on learning in Canada (n=92) and found that nursing students perceived the VSG to be beneficial and helpful in their knowledge and learning. In a descriptive and convergent mixed-method study conducted to analyze nursing students' views with VS(vSim for Nursing) in surgical nursing in Norway (n=65), Tjoflåt et al., (2018) found that the majority of student nurses perceived VS as helpful to enhance learning, acquire the latest knowledge, and strengthen existing knowledge.

Furthermore, the participants in the current study felt that participating in VS aided them in reinforcing and remembering what they had learned. In a qualitative study conducted by Liaw et al., (2021) to investigate the perceptions of students and facilitators on the use of a 3-dimensional virtual world(3DVW) for interprofessional team-based VS in Singapore (n=42), senior healthcare students revealed the flexibility in learning via VS that enabled contextual, supportive and practical learning. Similarly, nursing students expressed that screen-based computer simulation(SBCS) provided them detailed information that combined previously learned information with new knowledge and helped them better understand the subject in a qualitative study by Edeer & Sarikaya (2018) which aimed to understand the experiences of second-year nursing students on VS in Turkey(n=28). In a mixed-method study conducted by Chang et al., (2019) to examine the learning related to labour and delivery of babies by using spherical video-based virtual reality(SVVR) for nursing students in Taiwan (n=64), participants involved in SVVR reported that they could simultaneously remember the content, images, and graphics of birthing knowledge while thinking in depth. Correspondingly, participants in the current study highlighted the VS's step-by-step learning process, visuals, and application of theoretical knowledge in practice, claiming that this type of learning was not only easy but also retained in future clinical practice. Whilst students perceived that there is an improvement in knowledge acquisition, it is not clear from this study or the wider literature how long knowledge is retained or the impact of this knowledge on patient outcomes. Thus, it may be beneficial to conduct further research in the form of a

longitudinal study to determine how long knowledge is retained and whether this has an impact on mortality.

5.3.3 Impact on decision-making skills

Another important theme raised from participants' perceptions was the ability of the VS to enhance their decision-making skills and its retention. They confessed that they couldn't implement their judgment skills in clinical settings and had to rely on seniors, but they were allowed to offer care on their own in VS as it had provided them with a safe environment in which they could access and improve their decision-making abilities. This finding is similar to the results of a mixed-method feasibility study conducted by Adhikari et al., (2021) to analyze the acceptability and applicability of sepsis games in nursing education in the UK(n=19), where participants reported that the game helped them to exercise decision-making skills independently. Similarly, 98.7% of participants in VS expressed an enhancement of decision-making skills in a quasi-experimental study conducted by Elcokany et al., (2021) to explore the influence of computer-based scenarios on students' decision-making skills in Saudi Arabia (n=112). A decision support system suggests that confidence, knowledge, and heuristics or experience are key to quality decision-making (Kasper, 1996). And this simulation has an impact on these, allowing the students to learn experientially, gaining knowledge and confidence in the process. Thus, it could be hypothesized that it will have an impact on decision-making and patient outcomes. This hypothesis needs to be tested in the future but the results from this study are promising.

5.3.4 Usability of VS

In this study, the majority of the participants experienced the simulation game as user-friendly and easy to understand. They also mentioned that the game was interactive, participatory, and self-explanatory. This result is consistent with the findings of other investigations (Carrard et al., 2020; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). Carrard et al., (2020) conducted a qualitative study with 23 fourth-year medical students in Switzerland to learn about their perspectives on the benefits of using a VS during breaking bad news(BBN) training in undergraduate medical school, where participants emphasized the usability of the VS and the importance of self-observation during BBN training. Nursing students involved in the usability survey by Luctkar-Flude et al., (2021) found the VS to be

relevant and simple to use. Correspondingly, participants in the current study regarded the VS game as simple to learn and contribute to their learning during pandemic situations.

In a mixed-method study conducted by Foronda et al., (2018) to investigate nursing students' experiences of learning from VS (vSim for nursing) in the United States (n=99), 77% of students perceived the VS was efficient and real, which helped them to learn more effectively. In a qualitative study by Edeer & Sarikaya (2018), nursing students highlighted VS as being highly efficient and productive in their therapeutic encounters whereas participants perceived VS useful for learning step-by-step process of nursing care in a mixed-method study by Donovan et al., (2018). They also praised the VS's ability to be reused which facilitates better learning and understanding. Similarly, participants in the present study considered the VS was simple to use and learn, making it more efficient and recommending its transferability to middle- and lower-income nations.

Additionally, the participants in the current study perceived the VS as entertaining and engaging. They claimed that the game was so realistic that they felt entirely engaged in it and as if they were in a real-life crisis. Identical results were noted in qualitative studies done by Edeer & Sarikaya (2018) and Liaw et al., (2021), in which participants found the VS to be understandable, attractive, and engaging. They highlighted that the VS was relevant to real-life scenarios since they could sense the patients' feelings via voice. Similarly, Verkuyl et al., (2019) performed usability testing to assess the ease of use and utility of an interactive digital simulation table to promote acceptance of technology before integration with a nursing program in Canada (n=15) and found the simulation to be useful, enjoyable, and interactive.

Conversely, a small number of nursing students in the current study were dissatisfied with the VS, describing it as complicated and challenging. It could be due to a lack of interest in the technology or a preference for the traditional learning technique. This negative impact of the game corresponds with the result of a mixed-method study by Verkuyl et al., (2019), in which participants criticized the VS and described it as frustrating, confusing, and unclear. They also complained about being unable to lift the bed and auscultate the posterior part of the chest during the respiratory examination. When it came to technology, participants perceived VS as strange and unpleasant, making it tedious to explore due to the language barrier and unfamiliarity with VS (Kim et al., 2021). Even though the scenario seemed realistic, they experienced a shortage of authenticity owing to the absence of direct touch with the patient.

Similarly, nursing students in a mixed-method study struggled to understand VS(vSim for nursing) due to the language barrier(use of the English language) (Tjoflåt et al., 2018). Even though there was no linguistic barrier in the current study, a small proportion of participants voiced unhappiness with VS and its complications. Regular use and proper orientation of VS through instructional video could reduce these concerns.

5.3.5 Perceptions of VS in comparison with a clinical simulation

According to the participants in the current study, VS was more effective, practical, and informative than CS. They also mentioned that VS provided them with the same knowledge more conveniently and readily than CS. This finding is supported by a randomized quasi-experimental study conducted by Wiese et al., (2021) in the United States to determine if pre-registered nursing students gained more knowledge from a live or virtual disaster simulation (n=80), with students gaining more knowledge following virtual disaster simulation (M=20.55, SD=4.75) as compared to live disaster simulation (M=15.93, SD=6.44). Furthermore, the participants of the VS reported that the availability of good quality and comprehensive information provided them with a great deal of learning and understanding (Wiese et al., 2021). Participants in the present research remarked that while some experiential learning is hard to gain via CS, it is easily accessible in a virtual world. Similarly, the quantitative analysis showed no significant difference in the knowledge score between participants of CS and VS (21.4 ± 1.6 and 19.8 ± 2.1 respectively, $p=0.02$), implying that VS is equally effective as CS.

In an RCT conducted by Liaw et al., (2014) to compare the effectiveness of VS and CS in Singapore (n=57), both simulation groups performed significantly better in the first and second post-test than pre-test and CS led to significantly higher learning retention than VS. In contrast, Cobbett & Snelgrove-Clarke, (2016) found that anxiety levels of nursing students were significantly higher for the virtual group in comparison to clinical group (M=73.26 vs 57.75, $t=-3.2$; $p=0.002$) with no obvious differences in knowledge acquisition and self-confidence in a randomized pretest-posttest study aimed to evaluate the efficiency of virtual and clinical simulation in Canada(n=56). This result is concurrent to the findings of the quantitative study of the effectiveness of the COVID-19 scenario game, which showed that VS group had a greater anxiety level (2.5 ± 0.8) than CS (2.0 ± 0.5). Nevertheless, participants claimed that the VS is more helpful and less stressful as it can be practiced at any time, from

any place, and offered them superior clinical concepts. They also indicated it as an effective teaching-learning tool for enhancing knowledge and self-judgment via feedback suggesting that the VS can be used as a formative examination tool for measuring clinical competency.

Subsequently, participants in the current qualitative survey enlightened that VS might not only supplement but also could replace CS. They indicated that the VS gave them comprehend of CS and act as a pre-practice before being exposed to the clinical practice. The findings of different studies back up this assertion (Edeer & Sarikaya 2018; Luctkar-Flude et al., 2021; Verkuyl et al., 2019). Participants in these studies reported that VS alone was insufficient for their learning and it should be complemented with CS. Similarly, the student nurses enrolled in Luctkar-Flude et al., (2021)'s usability survey claimed that exploring the VS before CS as a pre-simulation preparation was preferable. Curtin et al., (2011) conducted a single-center, randomized control study with third-year PharmD students to evaluate the effects of VS on the fulfillment of students' learning goals during mannequin-based simulation in the United States (n=200) and found that participants exposed to VS before mannequin-based simulation had 41.2% of patient survival, which was significantly higher than 5.6% in mannequin-based simulation (p=0.018). They also believed that the VS should be performed first, followed by the mannequin-based simulation. The current study backs up this notion, with participants praising VS as a pre-practice before CS. Moreover, VS can be applied as a pre-simulation practice before exposure to CS.

Despite its usability, most of the participants in the present study believed in 'learning by doing' and preferred CS. They also emphasized the importance of the human element in nursing, that simulation can't replace, and expressed disappointment with the inability to provide compassionate care to the patient in VS. Correspondingly, Cobbett & Snelgrove-Clarke, (2016) found that over 90% of nursing students favored CS over VS in a randomized pretest-posttest design. They cited technological issues as the most common cause for their dislikes of the VS. In a mixed-method study conducted by Foronda et al., (2018), 5% of nursing students valued VS instead of manikin-based simulation. However, Duff et al., (2016) reported that VS was similar or preferable to traditional simulation methods in terms of higher involvement and gaining knowledge in a secure setting with easy accessibility in a scoping review, that aimed to study the use of VS in healthcare education in teaching diagnostic reasoning in Canada (n=12). Out of 11 participants who had responded about their preferences between VS and CS in the current study, 7 voted for CS although few students

rationalized their choice for VS as a safer and realistic approach.

5.3.6 Participants' suggestion for areas of improvement in VS

Qualitative data analysis in the current study revealed that the participants highlighted enhancement in technology, navigational instructions, and educational content to promote the game's utility and friendliness. Similarly, participants of the qualitative studies (Carrard et al., 2020; Liaw et al., 2021) urged for the addition of unambiguous instructions and onscreen guidelines in VS. In the qualitative study by Kim et al., (2021), participants expressed that providing students with a pre-practice orientation on the use of VS would be beneficial. Similarly, the researcher of this study had prepared an instructional video to orient the students before VS. Nevertheless, this video was not used constantly as all the students were involved in an online teaching-learning program and most of them were comfortable in playing the game without any obstacles.

Additionally, the participants in the current study recommended that more information be provided to enhance their knowledge and understanding. They argued for a more in-depth explanation and rationale that were relevant to the scenario. Likewise, participants in Carrard et al., (2020) and Edeer & Sarikaya, (2018)'s qualitative studies recommended increasing the visual content and providing feedback to aid learning. In the present study, participants were given a workbook consisting of theoretical background on the management of COVID-19 pneumonia to learn before engaging in VS. However, some of them did not thoroughly study it and instead suggested a clear and rational clinical case analysis. Thus, the researcher should ensure that the participants read the workbook via an online verification system. Alongside, this game contains a feedback section, which the researcher should assure the participants reviewed after playing it.

Regarding simulation technology, the current study's participants suggested technical advancement. They advised for the addition of more interaction in VS, as well as control over the cursor and screen sensitivity. In the qualitative study by Carrard et al., (2020), medical students considered the improvement of interactivity and quality of virtual patients in VS along with its variation and structure. In the case of the importance of interactivity in VS, H. Kim & Suh, (2018) conducted an RCT to assess the impacts of an interactive mobile application for nursing students in South Korea (n=66) and observed that interactivity aids in

increasing knowledge and self-efficacy. Similarly, participants in a mixed-method study by Luctkar-Flude et al., (2021) proposed lengthening the VS to enhance knowledge while participants were advised to decrease the sensitivity of the screen to touch and navigate in a mixed-method study by Verkuyl et al., (2019). Accordingly, suggested technical modifications will be implemented in the COVID-19 scenario game, and developers will also endeavor to provide more interaction and alter cursor and screen sensitivity in future VS.

5.4 Strengths of the study

The population of the current study was second-and third-year Bachelor of Nursing students. These students were chosen as the study's population because they had experienced the COVID-19 pandemic and will be the future nurses who will care for a patient suspected of COVID-19 pneumonia. Moreover, they were the participants of the VS in a randomized control trial. Since they were exposed to VS, they were deemed capable of providing perceptions and experiences on applicability and usability of the VS. Furthermore, the researcher opined that including students from various stages of nursing school aided in gathering a broader range of viewpoints.

Subsequently, a qualitative strategy was adopted in this study, which the researcher believes was an appropriate method and another strength of the study. As the major goal of the study was to explore the nursing students' perceptions regarding the applicability and usability of the VS, qualitative research can enable researchers better comprehend their thoughts and feelings (Sutton & Austin, 2015). Additionally, the qualitative descriptive approach applied in this study emphasizes the subjectivity of the topic and produces a conclusion that corresponds to the research question (Bradshaw et al., 2017).

Furthermore, the sample size was determined by the data saturation which was another strength. Although some researchers claimed that data saturation was unachievable, ineffective, questionable, and controversial (Ironside, 2006; O'Reilly & Parker, 2013), these effects were reduced by evaluating the research design, sampling process, and the relative frequency of the events being studied as suggested by Fusch & Ness, (2015) and O'Reilly & Parker, (2013). However, information power can be employed instead of data saturation where the sample size is determined by the quantity of information retained from the sample

(Malterud et al., 2016).

Similarly, one-to-one interviews were conducted to gain information on the nursing students' perceptions on applicability and utility of VS. According to Guest et al., (2017), individual interviews offered a greater depth of data than focus group discussion and provided a deeper understanding of a participants' personal opinions and experiences. After data collection, data analysis was done using an abductive approach which was another positive element of the study. The abductive analysis is a combination of deductive and inductive processes that allows for greater accessibility and flexibility when coding data and detecting themes (Råholm, 2010).

Likewise, the semi-structured questionnaire used for the interview was a strong component of the study. It helped the interviewer by asking questions in a succession of the interview as well as interrogating spontaneous concerns raised by the participants (Ryan et al., 2009). Moreover, the interviews were led by the team member, who was neither involved in the educational module of the participants nor in the development of the game which could have prevented any potential bias.

5.5 Limitations of the study

There are several limitations to this research. To begin, this study included the participants from a single university. Examining the impact of VS among nursing students at various universities could provide a wide variety of data. Data from longitudinal studies conducted at institutions across different locations would enhance the importance and quality of the study findings, as well as provide nursing students more possibilities to learn and understand. The social-desirability bias was another limitation. The social-desirability bias emerged, as it didn't provide an equal chance of participation and enhanced the risk of outlier difficulties, which could be destructive due to the self-reporting and voluntary participation of the sample (Etikan, 2016).

Chapter 6 - Conclusion and recommendations

6.1 Conclusion

A qualitative study was conducted to explore nursing students' perceptions of VS in terms of impact, confidence, decision-making skills, and comparability to CS at Edinburgh Napier University. The study was conducted using convenience sampling. To achieve the objective of the study, one-to-one interviews were conducted. The results of this study showed that students perceived VS as interactive, participatory, user-friendly, and self-explanatory. In the case of usability, they claimed the VS was simple, straightforward, and easy to understand. They found the game was engaging and enjoyable. Moreover, students reported that the VS increased their confidence while diminishing their anxiety, comprehension, and errors.

The nursing students' perception of the VS reported that it enhanced their knowledge and decision-making skills. They were impressed with the reinforcement and retention of knowledge as well as decision-making skills after participating in VS. While comparing with the CS, the students perceived the VS was more efficient, effective, and informative. They further claimed that the VS can not only supplement but also replace the CS where presentational simulation isn't possible. However, nursing students prefer CS over VS because they appreciate hands-on learning. Despite VS's usability and applicability, students suggested improving realism and engagement by adding navigational guidance and knowledge as well as technical upgrades: interaction with avatars and controlling the cursor sensitivity. Hence, the technician should implement the suggested improvement to enhance the usability and applicability of the VS.

To conclude, this study demonstrated that the nursing students perceived VS as a useful and applicable tool to improve their confidence, knowledge, and decision-making skill. Hence, VS can be used to complement the CS as a pre-simulation practice or replace it where presentational simulation is not viable. Since the VS was designed to improve confidence, knowledge, and decision-making skills and participants showed a positive perception of usability and applicability of VS in this study, the researcher believes that the VS will provide the greatest value to the nursing students in this pandemic situation where presentational simulation is restricted, while a combination of both simulations can be beneficial post-pandemic.

6.2 Implications of the study to practice and policy-making

6.2.1 Implication on practice: Replacement for clinical simulation

This qualitative study revealed that participants perceived VS as advantageous and similar to a real-life setting, suggesting that it might be used to substitute CS. However, the participants advocated the importance of CS in nursing education. Students can use the VS whenever and wherever they want until they master it (Kim et al., 2021), resulting in improved clinical skills, critical thinking, and self-confidence (Foronda et al., 2020). Hence, VS may be a suitable substitute to consider for educating students where presentational simulation isn't possible or available. Nonetheless, additional large-scale study into the students' achievements and their perceptions of VS is essential to implement the VS in practice by replacing CS.

6.2.2 Implication on policy: Useful as pre-simulation practice

- Participants reported that VS was more effective, practical, and provided them a better awareness of the clinical issue, so it could be implemented as a pre-simulation practice before CS. They also mentioned that VS is beneficial and less stressful. However, they argued that VS itself was insufficient for learning and should be combined with the CS for better understanding. Various studies had echoed similar sentiments (Luctkar-Flude et al., 2021; Verkuyl et al., 2019). Hence, this study's result implies the curriculum-developers to integrate VS as a pre-simulation exercise in the training of the pre-registration nursing students. Furthermore, this implication must be evaluated from the perspective of a large-scale study.

6.3 Recommendations for future studies

6.3.1 Recommendation in policy

- VS can be applied as a pre-simulation practice before exposure to CS and is recommended to establish the policy decision to make it a pre-simulation exercise in nursing education,

6.3.2 Recommendation in practice

- To familiarise students with VS, an instructional video is recommended.
- VS can be used as a formative examination tool for measuring clinical competency.

- VS is simple to use and learn, making it more efficient when the presential simulation isn't possible, and recommends its transferability to middle and lower-income nations where simulation facilities are limited.

6.3.3 Recommendation for research

- It could be hypothesized that VS will have an impact on decision-making and patient outcomes. This hypothesis needs to be tested in the future.
- Further study should be conducted to determine how long the knowledge acquired via VS will be retained and whether this has an impact on patient outcomes.

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Appendices

Appendix 1: Oath of Confidentiality

Oath of Confidentiality

EDINBURGH NAPIER UNIVERSITY

**OATH OF CONFIDENTIALITY – RESEARCH STUDENT
(General Data Protection Regulation and Data Protection Act 2018)**

Full name	ANU KOJU	Matriculation No.	40516832
Course	Master in Nursing	School	Edinburgh Napier University
<p>I acknowledge that for the purposes of my dissertation/research project at the University, I will have access to the personal information of living identifiable individuals. I recognise that I have a duty of confidentiality in relation to this information and am bound by the provisions of the Data Protection legislation and the University's obligations under the legislation.</p> <p>As a University research student I undertake to:</p> <ul style="list-style-type: none"> • only ever access and process personal information in order to carry out my research • never use any such data for any purpose other than to perform my research • never disclose the data to any other person at the University <u>except</u> where appropriate to my research supervisor and/or other authorised person • never disclose any data to any individual or organisation external to the University, (other than an external examiner/supervisor as required) in accordance with the legislation • securely retain the data in both electronic and manual format at all times. Manual/paper records/data to be kept in a locked container and electronic data to be stored only on the University's ICT network/systems as per guidance provided online at: https://staff.napier.ac.uk/services/governance-compliance/governance/DataProtection/Pages/ProcessingDataforResearch.aspx . • securely dispose of the data in accordance with relevant retention requirements and University policy • adhere to the obligations set out above and below during my period of research and after it has ended <p>I understand that:</p> <ul style="list-style-type: none"> • disclosure or processing of personal information outside these terms will only take place in consultation with my research supervisor and/or Governance and Compliance Services • where relevant, I am bound by the University's Information Security, Manual Data Security policies and Data protection Policy and CoP to which I have been directed (see link above) • I may be subject to disciplinary proceedings for failing to observe these obligations 			
Signed		Date	17/6/2021
Witness (staff member)			
Name			
School		Post held	
Signed		Date	

Appendix 2: SHSC Ethics Application Form

1. Research Details

Name of Lead Researcher (PI):	Dr Ruth Paterson
Names of other Researchers/DOS/Supervisors	Ms Jane Whitehorn. Anu Koju (MSc Student)
School or Professional service department:	School of Health and Social Care
Email:	r.paterson@napier.ac.uk
Contact number:	0131 455-5663
Project Title:	Is digital simulation as effective as on campus simulation: a knowledge acquisition, confidence and economic evaluation
Start Date (data collection):	July 2021
End Date (data collection):	July 2022
Is anybody funding this research? (Amount and Source)	No
Type of Research/Level of Studies: i.e. UG/Taught PG/Masters/PhD Student/ Staff/External	Staff and masters student
Name of Independent Advisor	Dr Janette Pow.

2. Screening Questions

Please answer the following questions to identify the level of risk in the proposed project:

If you answer ‘No’ to all questions, please complete Section 3a only.

If you have answered ‘Yes’ to any of the questions 7-17 please complete Section 3a and 3b.

If you have answered ‘Yes to any of the questions 1-6, complete all of Section 3.

You Must Answer All Questions		Yes	No
1.	Is the research a Clinical Trial?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.	Is the research in a health care setting?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3.	Is the research investigating socially or culturally ‘controversial’ topics (for example pornography, extremist politics, or illegal activities)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.	Will any covert research method be used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5.	Will the research involve deliberately misleading participants (deception) in any way?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6.	Does the research involve the researcher travelling to another country or involve participants outside the UK?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7.	Does the Research involve staff or students within the University?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.	Does the Research involve vulnerable people? (For example people under 18 or over 70 years of age, disabled (either physically or mentally), those with learning difficulties, people in custody, migrants etc).	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9.	Is the information gathered from participants of a sensitive or personal nature?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10.	Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11.	Have you identified any potential risks to the researcher in carrying out the research? (for example physical/emotional/social/economic risks?)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
12.	Is there a possible conflict of interest between researcher and participant that would affect the voluntary nature of the participation, e.g. managerial influence, Research using current students as participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13.	Will the research require the use of assumed consent rather than informed consent? (For example when it may be impossible to obtain informed consent due to the setting for the research – e.g. observational studies/videoing/photography within a public space)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
14.	Is there any risk to respondents’ anonymity in any report/thesis/publication from the research, even if real names are not used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
15.	Will any payment or reward be made to participants, beyond reimbursement or out-of-pocket expenses?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
16.	Does the research require external ethics clearance? (For example from the NHS or another institution)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
17.	Does the research involve the use of secondary datasets?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3A. Details of Project

In this section please provide details of your project and outline data collection methods, how participant consent will be given as well as details of storage and dissemination.

Please give a 300 word overview of the research project

Background information (300 words maximum; references should be cited and listed)

COVID-19 is a public health emergency, resulting in an unprecedented threat to global health and well being. Mortality increases according to severity of disease and adopting a systematic and person centred approach to the management of the acutely ill person

presenting with COVID-19 is reported to improve outcomes (Sun et al 2020). 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 (Brydges, Hatala, Zendejas, Erwin, & Cook, 2015). During lockdown this was impossible and alternative approaches to simulation education were developed.

A team at Edinburgh Napier University were approached by NHS Education for Scotland to 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 (Parreno et al., 2016). Immediate feedback improves the precise understanding of the subject area and is viewed as a valuable educational approach (Connolly & Stansfield, 2007).

Justification for the research (what might the impact on your practice or the practice of others)?

The impact of interactive online simulation is novel and its impact on learning is not well evidenced in the literature. The Nursing and Midwifery Council have placed greater emphasis on simulated learning activities yet it is not clear whether digital simulation is an effective learning opportunity as a campus simulation. 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 experiences into their curriculum. Online learning has increased since the COVID pandemic and its flexibility for the 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 a stimulus for future work in this area including the development of providing further evidence of its continued use.

Aims and/or research questions

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

Aims

1. To compare knowledge acquisition between students undertaking digital simulation to those undertaking on-campus simulation.
2. To compare pre and confidence between
3. To compare the cost of digital simulation to on campus simulation
4. To explore with students their perceptions of digital simulation compared to on-campus simulation.

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<https://ezp.napier.ac.uk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2015-10051-020&site=ehost-live>

[Connolly, T., & Stansfield M. \(2007\) "From eLearning to Online Games-based eLearning: Implication and Challenges for Higher Education and Training." Social Implications and Challenges of E-Business \(Ed: F. Li\). Idea-Group Publishing: Hershey. ISBN 1599041057 pp. 42-56](#)

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<https://login.ezproxy.napier.ac.uk/login?url=https%3A%2F%2Fsearch.proquest.com%2Fdocview%2F1492915248%3Faccountid%3D16607>

o enter text.

Data Collection	
1.	<p>Who will be the participants in the research?</p> <p>Number & nature of sample (include sample size calculation if applicable): To obtain a comprehensive range of views, any worker who has accessed the open access and student resource will be invited to participate in the online survey. Follow-up interviews will be carried out with a purposive sample of participants of the online survey.</p> <p>Inclusion/exclusion criteria:</p> <p>Inclusion criteria</p> <ul style="list-style-type: none"> • All second and final year nursing students at Edinburgh Napier University (research aims 1,2,3) • Students who participated in digital arm of the student (research aim 4)
2.	<p>How will you collect and analyse the research data? (please outline all methods e.g. questionnaires/focus groups/internet searches/literature searches/interviews/observation)</p> <p>Quantitative data collection:</p> <p>Procedure: Prior to the simulation session, all students will be provided with a workbook with background theory on care of a person presenting with COVID-19 pneumonia. Students will then be randomly allocated the digital or simulated scenario.</p> <p>Research aim 1: students will be expected to make treatment and care decisions relating to immediate care and management, interpretation of investigations, definitive treatment options and ongoing management and referral. Using predetermined marking criteria embedded students will be allocated a score.</p> <p>Research aim 2: a validated self-reported self-efficacy score will be administered pre and post intervention (NASC-CDM), (White, 2014).</p> <p>Research Aim 3: Cost utility analysis This will cover three specific areas:</p> <ol style="list-style-type: none"> a. The resources required to create the intervention, b. The consumables required to carry out the intervention, high fidelity mannequin, laptop. c. Staff time to support intervention. <p>Quantitative data analysis:</p> <p>Quantitative analysis will be carried out with using SPSS or similar package. This will measure the overall research aims of the COVID simulation between the two groups (digital or simulated). Scores will be computed and reported (overall and for each group (mean, SD and range) and paired T-tests will be performed to detect differences between the two groups with $p < 0.05$ defined as significant.</p> <p>Qualitative Data collection</p> <p>To meet research aim 4 a qualitative exploration of participants' perceptions of the digital or simulation scenario. It will explore their views of the acceptability of the technology and impact the intervention has had on their knowledge and skills when a person with</p>

	<p>suspected COVID-19 who is clinically deteriorating is presented to them. An online semi structured interview using a pre-determined topic guide will be conducted lasting no more than 30 minutes. The interviews will be conducted by one of the research team all of whom are qualified health care professionals.</p> <p>Qualitative Data analysis Interviews will be digitally recorded using microsoft teams. After completion, the audio files will be onto the university's secure server. Recordings will be transcribed, coded and organised into themes using NVIVO software. Themes will be checked and verified by 2 members of the research team.</p> <p>Linking of qualitative and quantitative data. Personal information recorded on the data collection form will be year and programme of study/or number of years practicing as a healthcare worker.</p>
	<p><i>Please explain the reason for the particular method, estimated time commitment and how data will be analysed.</i></p> <p>The quantitative phase will allow the research team to measure the impact of the educational resource and game on confidence. It is anticipated that each participant will take 15 minutes to complete this phase.</p> <p>The qualitative phase will this phase will take around 30 minutes to complete.</p>
3.	<p>Where will the data will be gathered (e.g. in the classroom/on the street/telephone/online) online</p>
	<p><i>Focus group/interviews (provide details of themes/questions)</i> <i>Audio/video recordings (provide details, ensure permission is evidenced on consent form)</i> <i>Questionnaire (provide copy of questions or online link)</i> <i>Participant observation (provide observation proforma)</i> <i>Other</i></p> <p>The data will be gathered using university approved online platforms, for example NOVI survey and Microsoft teams, the NASC-CDM will be used to measure self efficacy and the topic guide will form the basis of the semi-structured interview.</p>
4.	<p>Risk Assessment. It should be clear from the comments provided that the potential risks have been considered and information provided on what they are, with evidence of what is being implemented to mitigate these (please consult Risk Assessment Guidance).</p>
	<p><i>Comment on the potential risks to participant</i> The research team do not envisage any risk to participation.</p> <p><i>Comment on the potential risk to researcher</i> The risk to the researcher is minimal, the researcher will be carrying out the study in their place of work and will have the support of the rest of the research team. Researcher fatigue may be a risk, however the support of the research team to ensure regular breaks are taken during data collection and write up will mitigate this.</p>
5.	<p>Does the project involve field work, lone working or travel to unfamiliar place (e.g. off campus) (please consult Risk Assessment Guidance)</p>
	no
6.	<p>If your research is based on secondary data, please outline the source, validity and reliability of the data set</p>
	Not applicable.
Consent and Participant Information	
7.	<p>How will you invite research participants to take part in the study? (e.g letter/email/asked in lecture)</p>

	<p>Recruitment of participants: All eligible participants will be contacted via their bachelor of nursing programme moodle platform. This will take place from 1 June 2021 to 21 September 2021. At this time students will be informed more fully of the study and reassured that this study is not linked to their academic work, their participation is voluntary and, if they wish, they are free to withdraw consent at any point during the study. Potential participants will be given 48 hours to consider their involvement in the study and will contact the main researcher to note interest. Once they have agreed to take part a link to the online consent form and survey will be forwarded and at that time they will be asked if they would be willing to participate in a qualitative interview. If they agree to take part in the qualitative phase contact details will be retained and a time agreed for the interview to take place.</p>
8.	How will you explain the nature and purpose of the research to participants?
	The nature and purpose of the research will be explained in written and verbal format
9.	How will you record obtaining informed consent from your participants?
	Consent will be recorded using a standard consent which will be completed in electronic format prior to enrolment in the online survey.
Data storage and Dissemination	
10.	How, where and in what format will data be stored? And what steps will be taken to ensure data is stored securely?
	<p>Location of storage Data identifiers kept in a secure room/facility Electronic data password protected</p> <p>Survey data will be anonymised and stored on the Nori-survey platform . Excel will be used for quantitative data storage and SPSS for quantitative data analysis.</p> <p>Audio-recordings will be transferred onto secure storage and the recording on the encrypted device destroyed within a week of the interview. Electronic transcripts will be saved in textual form using MS Word and NVIVO software.</p> <p>At the end of the research, electronic 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. Participant contact information will be separated from research data and securely stored until the end of the research project. All electronic files containing data will be deleted from the secure university server where the data is held.</p>
11.	Who will have access to the data?
	Members of the research team.
12.	What methods are used to protect the privacy of the participants, including the degree anonymity?
	Participants will be allocated a unique identifier and all identifiers stored separately from research data.
13.	How long will the data be kept?
	At the end of the research, electronic 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.
14.	What will be done with the data at the end of the project?
	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.
15.	How will the findings be disseminated, including made available to participants?
	Findings will be disseminated through publication in academic journals and will be made available to participants via the moodle platform.
16.	Will any individual be identifiable in the findings?
	No

3B. Identification and Mitigation of Potential risks

This section is designed to identify any realistic risks to the participants and how you propose to deal with it.

1. Does this research project involve working with potentially vulnerable individuals?

Group	Yes	NO	Details (for example programme student enrolled on, or details of children's age/care situation, disability)
Students at ENU	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Students enrolled on the BN (Adult) Nursing programme
Staff at ENU	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Children under 18	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Pregnant persons	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Elderly (over 70)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Physical disabilities	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Migrant workers	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Prisoners / people in custody	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Cognitive problems/Learning difficulties	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Linguistic/communication difficulties	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

2. If you are recruiting children (under 18 years) or people who are otherwise unable to give informed consent, please give full details of how you will obtain consent from parents, guardians, carers etc.

Not applicable

3. Please describe any identified risks to participants or the researcher as a result of this research being carried out.

No identified risk..

4. Please describe what steps have been taken to reduce these identified risks? (for example providing contact details for appropriate support services (e.g. University Counselling, Samaritans), reminding participants of their right to withdraw and/or not answering questions, or providing a full debriefing to participants and understanding the responsibility of the researcher when dealing with confidential and sensitive information).

Not applicable.

5. If you plan to use assumed consent rather than informed consent please outline why this is necessary.

Not applicable,

6. If payment or reward will be made to participants please justify that the amount and type are appropriate (for example the amount should not be so high that participants would be financially coerced into taking part, or that the type of reward is appropriate to the research topic).

No payment or award to be given.

3C. Justification of High Risk Projects

If you answered 'Yes' to the screening questions 1-6 this section asks for justification on the choice of research topic and methodology. The Reviewers have the right to refer high risk applications to the Research Integrity Committee for approval.

1. If you have answered yes to question 1, please give a full description of all clinical procedures (Note this is for non-NHS studies only. If the study involves NHS participants, staff or premises please complete the IRAS application and submit PDF for risk assessment)

The participants in the study are students at Edinburgh Napier and may feel under pressure to participate in the study. Participants and potential participants will be reassured that participation or non-participation will have no effect on any part of their programme of study and participation is voluntary.

2. If you have answered yes to question 2, please give a full description of the health care setting and what steps have been taken to reduce any potential risks and describe how you have gained permission from the Organisation.

n/a

3. If you have answered yes to questions 3 (research into a controversial topic), please provide a justification for your choice of research topic, and describe how you would deal with any potential issues arising from researching that topic.

N/a

4. If you have answered yes to questions 4 or 5 (use of deception or covert research methods) please provide a justification for your choice of methodology, and state how you will mitigate the risks associated with these approaches.

n/a

5. If you have answered yes to questions 6 (overseas research) please provide details on how the research will be conducted in another country (note the research should comply with UK ethical and legal requirements). Please state the procedures/permissions for ethical approval and the sponsorship agreement with the relevant institution(s) in the country where the research will be conducted. Note it will be important to ensure that the research is covered by the University Insurance coverage.

n/a

Declaration

The application will NOT be accepted if this section is blank or incomplete

- The information contained herein is, to the best of knowledge and belief, accurate
- The project will abide by the Edinburgh Napier University's policies and procedures
- I undertake to inform the SHSC ethics of significant changes and amendments to the protocol
- I am aware of my responsibility to be up to date and comply with the requirements of law and relevant guidelines relating to security and confidentiality of personal data.
- I understand that the project, including research records and data may be subject to inspection for audit purposes, if required in the future.

Please note that by submitting this application the supervisor confirms that:

- The student is aware of the School ethics requirements
- The topic merits further research
- The student has relevant skills to begin research
- The procedures for collecting data, recruitment and obtaining informed consent are appropriate
- Required resources/support have been approved for this study by Head of School/Director of Research.

By signing below (digital signatures accepted) you certify that the information provided is accurate and true reflection of the study. Applicants should expect to get an acknowledgment within 3 working days that their application for full ethical review, including all supporting documents have been received. If you do not hear, please contact SHSC ethics - ethics.shsc@napier.ac.uk



I confirm that I have considered the ethical risks arising from this project and have provided accurate information and the research will be conducted in the manner described.

Researcher Signature:

Date:

Director of Studies/Supervisor/Principal Investigator Signature:

Date:



15/07/20

Application Form and Document Checklist

All applications require the following to be submitted with the application form

All relevant fields are completed

Sections 1 and 2 of the application must be complete and relevant sections related to 3a, 3b and/or 3c must be completed as per answers to screening questions (1-17).



Application is submitted 4 weeks in advance of data collection

Please ensure that the date of data collection is clearly stated and allows for sufficient time for ethical review and any updates/amendments that may be required. Data collection should not start before ethical approval is given.



<p>Includes a Participant Information Sheet (plain language summary) on headed paper For examples we recommend that you use the HRA: http://www.hra-decisiontools.org.uk/consent/</p>	☒
<p>Includes an Informed Consent Form on headed paper For examples we recommend that you use the HRA: http://www.hra-decisiontools.org.uk/consent/</p>	☒
<p>Includes protocol (as required) Please see protocol template in list of ethics application documents</p>	☒
<p>Includes Interview/Survey Questions/Audio/Video-recording/Poster/Debrief (as required) Please note;</p> <p>*NACS-CDM self efficacy score will follow with an amendment*</p> <p><i>Provide a copy of questionnaire; interview themes/online questionnaire URL or observation proforma (an indicative list can be sent, but final version must be sent as amendment prior to data collection if not provided in the initial application)</i> <i>If audio/video-recording are used please make sure the permission is evidenced in the consent form</i> <i>The recruitment poster, social media statement etc must include the researcher/supervisor contact details; statement that the named individual can be contacted for further information about project; and a statement that the study has received relevant ethical approvals</i> <i>A debrief may be required for some studies in order to sign-post participants to relevant support services at the end of the study</i></p>	☒
<p>Includes data sharing agreement or privacy impact statement (as required) If required please contact RIO and Governance offices for advice (i.e. use of secondary data sets, data sharing with other universities nationally or internationally)</p>	☒
<p>Has attached written permission(s) from relevant outside organisation(s) (as required) Written permissions are required from external organisations to recruit participants, collect data or use of premises</p>	☒
<p>Includes completed risk assessment form Please see risk assessment template in list of ethics application documents</p>	☒
<p>Includes relevant data management assessment form It is mandatory to complete the relevant data management form for your study, please see: https://staff.napier.ac.uk/services/research-innovation-office/research-data/Pages/Data-Management-Plan.aspx</p>	☒
<p>Includes a privacy statement It is mandatory to complete the privacy statement for participants. The form can be found at: https://staff.napier.ac.uk/services/governance-compliance/governance/DataProtection/Pages/ProcessingDataforResearch.aspx</p>	☒
<p>Students require to provide an oath of confidentiality Please see oath of confidentiality template in list of ethics application documents, please see: https://staff.napier.ac.uk/services/governance-compliance/governance/DataProtection/Pages/ProcessingDataforResearch.aspx</p>	☒
<p>The declaration is signed and dated</p>	☒
<p>The Director of Studies/Supervisor(s) have read, signed and dated the declaration (student requirement)</p>	☒

FOR OFFICE USE ONLY:

Date received

Reference number.....

Appropriate supporting documents, signed and dated

(White, 2014)

Appendix 3: Participant information sheet

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

Invitation and brief summary

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?

Participation in the study will involve:

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 4: Privacy statement

Privacy Notice

(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 then 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 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	<p>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: <i>What do health and social care students perceive the impact of a COVID-19 simulation game on confidence and knowledge acquisition?</i></p> <p>Aims</p> <ol style="list-style-type: none"> 5. To investigate the effect of the COVID 19 simulation game compared to a face to face simulation on confidence and knowledge acquisition 6. 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.

	<p>Where sensitive personal data is being processed the additional bases from Article 9 is:</p> <p>Art 9(2)(j) for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.</p> <p>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.</p> <p>In the unlikely event that special category personal data is collected, the University relies on Article 9(2)(j) for processing.</p>
<p>Whose information is being collected</p>	<p>Health and social care students who have accessed the online MOODLE resource.</p> <p>[Simulated practice for third year nursing students] (https://open.napier.ac.uk/course/view.php?id=34)</p>
<p>What type/classes/fields of information are collected</p>	<p>Please refer to data collection tool for full information.</p> <p>Participants will be identified and invited to participate from the online MOODLE platforms. No data or informatics will be extracted from the MOODLE site.</p> <p>On the consent form participants will be asked:</p> <ul style="list-style-type: none"> • Name • Email • phone number. <p>In the survey participants will be asked:</p> <ul style="list-style-type: none"> • year of study, • gender • and invited to complete a validated questionnaire that

	<p>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.</p> <p>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 acquisition of the resource and any improvement.</p>
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<p>Who is the information being collected from</p>	<p>Data is being collected directly from you as the participant in the study.</p> <p>We have identified you through the MOODLE space that you enrolled on to access the online resource.</p>
<p>How is the information being collected</p>	<p>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.</p> <p>Quantitative survey data files generated will be processed and stored electronically as SPSS system files with DDI XML documentation.</p> <p>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.</p>
<p>Is personal data shared externally</p>	<p>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.</p>
<p>How secure is the information</p>	<p>The data will be stored on on a secure University drive (X drive) that can only be accessed by the research team.</p> <p>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</p>

	<p>information security policies and procedures to ensure that appropriate organisational and technical measures are in place to protect the privacy of 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.</p>
Who keeps the information updated	The chief investigator will 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	<p>Consent forms = 6 years</p> <p>Audio recordings = kept until transcription completed (within 31 days).</p> <p>Transcriptions (pre anonymisation) = retained for 31 days to allow verification of meaning with participant.</p> <p>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.</p>
Will the data be used for any automated decision making	No
Is information transferred to a third country? Outside the EEA and not included in the adequate countries list.	No

You can access all the University's privacy notices using the following link:

<https://staff.napier.ac.uk/services/governance-compliance/governance/DataProtection/Pages/statement.aspx>

You have a number of rights available to you with regards to what personal data of yours is held by the University and how it is processed – to find out more about your rights, how to make a request and who to contact if you have any further queries about Data Protection please see the information online using the following URL: <https://staff.napier.ac.uk/services/governance-compliance/governance/DataProtection/Pages/default.aspx>

Appendix 5: Data Management plan

0. Proposal name
Evaluation of interactive simulation with pre-registration health care students: Recognition and Care of a deteriorating patient with suspected COVID-19; educational game
1. Description of the data
1.1 Type of study This mixed methods study, qualitative and quantitative will evaluate the above
1.2 Types of data Quantitative data from online surveys and qualitative data from online semi-structured interviews.
1.3 Format and scale of the data Quantitative survey data files generated will be processed and stored electronically as SPSS system files with DDI XML documentation. Textual data will be processed, anonymised and stored electronically as plain text data, and as an NVIVO file. All data will be non-identifiable.

2. Data collection / generation

Make sure you justify why new data collection or long term management is needed in your Case for Support. Focus in this template on the good practice and standards for ensuring new data are of high quality and processing is well documented.

2.1 Methodologies for data collection / generation

This study will test new technology and a novel pedagogical approach for pre-registration health education. What is known is that an immersive active educational experience has a positive impact on knowledge and skills. The gap in knowledge is how online simulation compares to laboratory based simulation. This study seeks to bridge this gap by directly comparing the two methods of simulation with pre-registration healthcare students. Students will be invited to participate via a community moodle. If they note interest in the study they will be provided with further information contained in the participant information sheet.

Once eligible participants agree to take part in the study, they will be asked if they would like to participate in the study. This information will be shared with the research team. Prior to quantitative data collection consent will be obtained. The quantitative data gathered will use a standardized assessment tool and a copyrighted instrument for the quantitative phase of the study. A reproduction of the instrument will be provided to the ethics committee as documentation for the data deposited with the intention that the instrument be distributed under "fair use" to permit data sharing, but it may not be disseminated by users. Permission has been sought from copyright holder to use the instrument and a copy of the letter is enclosed in the Ethics application. In the qualitative phase verbal consent will be recorded and transcribed. All identifiable data will be removed during transcription and following transcription audio files destroyed.

2.2 Data quality and standards

Standardised quantitative data capture will be through NOVI-survey. This is an online survey tool that will collect and report frequency data. No participant will be identifiable from their consent form. For the qualitative phase interviews will be digitally recorded using microsoft teams. After completion, the audio files will be onto the university's secure server. Recordings will be transcribed, coded and organised into themes using NVIVO software. Themes will be checked and verified by 2 members of the research team ensuring that themes identified are coherent, transparent and verifiable.

3. Data management, documentation and curation

Keep this section concise and accessible to readers who are not data-management experts. Focus on principles, systems and major standards. Focus on the main kind(s) of study data. Give brief examples and avoid long lists.

3.1 Managing, storing and curating data.

The survey data will be collected using NOVI survey and once data collection is completed the research

data from NOVI survey will be downloaded from NOVI survey on the **university x drive**. The qualitative interview data will be stored in the same way and audio files will be destroyed once analysis and verification on themes identified. All identifiable data will be removed from transcripts. Coding of themes will be carried out using NVIVO a qualitative data management system. Research data will be stored on **a secure drive (X-drive)** that can only be accessed by researcher team. **University-managed data storage** is resilient, with multiple copies stored in more than one physical location and protection against corruption. Daily backups are kept for 14 days and monthly backups for an additional year.

3.2 Metadata standards and data documentation

All research data will be organized as per the Universities metadata standards

<http://staff.napier.ac.uk/services/research-innovation-office/research-data/Pages/Organising.aspx>

3.3 Data preservation strategy and standards

The [Edinburgh Napier Data Management Policy](#) states requires research data to be retained after project completion if they substantiate research findings, are of potential long-term value or support a patent for at least 10 years. The policy also requires that funders and/or sponsors requirements are met. Long term storage is provided through the University data repository.

4. Data security and confidentiality of potentially disclosive information

4.1 Formal information/data security standards

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 of personal data..

4.2 Main risks to data security

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 of your personal data. Therefore, the risks to data security are small. All data will be stored and processed on university managed devices and disclosed data will be kept separate from anonymous data.

Participation in this study is confidential and all personal data will be anonymized. The information in this study will only be used in ways that will not reveal who the participant is. Participants will not be identified in any publication from this study or in any data files shared with other researchers outwith the research team identified on the ethics for. anticipation in this study is confidential. 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. In such cases no data will be identifiable.

MRC guidance on the [Confidentiality and data security](#) is provided (please see page 24 of the PDF file generated by selecting the above or adjacent [link](#)).

5. Data sharing and access

5.1 Suitability for sharing

Data generated by the project (identified above) may be made open once anonymised and can be shared openly once appropriate changes have been made to honour assurances of confidentiality and anonymity.

5.2 Discovery by potential users of the research data

Datasets will be allocated a DOI and stored on our open access Research Repository in accordance with the University research data deposit process. The DOI and the datasets will be made available to the UK repository within three months of the end of the study.

5.3 Governance of access

The chief investigator will make a decision about whether the data from this study can be shared. If there is agreement that anonymous data can be shared research data will be deposited in and available from an identified community database, repository, archive or other infrastructure established to curate and share data.

5.4 The study team's exclusive use of the data

Access to the data will be primarily for the research team for the purpose of this study. Any data shared will be anonymously within 10 years of study completion when in accordance with university policy will be destroyed.

5.5 Restrictions or delays to sharing, with planned actions to limit such restrictions

No personal data will be shared externally. In accordance with point 5.1 above data may be made open once anonymized.

5.6 Regulation of responsibilities of users

External users are (will be) bound by [data sharing agreements](#), and will be required to comply with the data sharing agreement. Prior to any data sharing a staff checklist for data sharing will be completed. All external users will have to confirm they can demonstrate compliance to GDPR legislation. Further information about requirements about data sharing can be found on the links to documents identified in Section 7 of this document.

6. Responsibilities

The first point of contact for all queries in relation to this data is the Chief investigator. Who will also have overall responsibility for the production and maintenance of metadata. Preparation and upload of the data will be carried out by the team with the support of the University's Information Services staff.

7. Relevant institutional, departmental or study policies on data sharing and data security	
Policy	URL or Reference
Data Management Policy & Procedures	http://staff.napier.ac.uk/services/research-innovation-office/Documents/Research%20Data%20Management%20Policy.pdf
Data Security Policy	http://staff.napier.ac.uk/services/cit/infosecurity/Pages/InformationSecurityPolicy.aspx
Data Sharing Policy	http://staff.napier.ac.uk/services/secretary/governance/DataProtection/Pages/DataSharing.aspx
Institutional Information Policy	
Other:	
Other	
8. Author of this Data Management Plan (Name) and, if different to that of the Principal Investigator, their telephone & email contact details	
<p>Ruth Paterson r.paterson@napier.ac.uk tel 0131-455-5663</p>	

Appendix 6: Qualitative interview topic guide.

Explanatory Note: This is a brief outline of what we are proposing to discuss.

Topic guide:

1. Having accessed the resource what impact do you think this had on your confidence to assess and treat a person who was clinically deteriorating with suspected COVID-19
2. What impact do you think that income may have on your clinical care?
3. What impact do you think the resource has had on knowledge and decision-making skills?
4. How did you find the usability of the resource?
5. In your experience how does this compare to clinical simulation?
6. Can you consider any areas for development or improvement with the resource?
7. Is there anything else you would like to add?

Appendix 7: Record of Meetings with the Supervisor

Date	Time	Points for discussion
28 th May 2021	3pm- 3:30pm	First meeting for conducting a research project. Ethical consideration for conducting a research project.
6 th June 2021		Oath of confidentiality signed
19 th August 2021	10:30am- 11:30am	Run through for the COVID-19 scenario. Planned for approaching the potential population to provide an overview of the research project and inviting them to participate.
7 th September 2021	11:30am- 12:00pm	Discussion regarding the research project. Discussion regarding the initial literature review. Planned and scheduled the dissertation project and meetings.
16 th September 2021	11:30am- 12:00pm	Discussion on data collection procedures. Power-point presentation to the potential participants and distribution of flyers for the invitation in the study.
29 th September 2021	10:00am- 11:00am	Discussion regarding the literature review. Structuring the layout of the literature review.
26 th October 2021	11:00am- 12:00pm	First draft of literature review submitted. Feedback on literature review section. Clarification of confusion in the meta-synthesis and critical appraisal of qualitative studies.
11 th November 2021	10:00am- 11:00am	Discussion on the method section. Organizing the layout of the method section. Clarification of confusions in the qualitative data analysis. Incorporating of bias and rigors in data collection and data analysis process.
	12:00pm- 1:00pm	Discussion on the qualitative data analysis using NVIVO software.

19 th November 2021		Draft of the method section submitted.
22 nd November 2021	1:00pm- 2:00pm	Discussion on sections 4 and 5. Revision of themes and sub-themes of the data collected.
23 rd November 2021		Feedback on the method section.
25 th November 2021		Draft on chapter 4- result section submitted.
6 th December 2021		Feedback on the result section received.
8 th December 2021		Draft on chapter 5- discussion section submitted.
17 th December 2021	11:45am- 12:30pm	Feedback on chapter 5- discussion section. Discussion on the gaming theory. Clarification of the confusion on the various section of the dissertation. Discussion of the implication of the study and recommendation to future research.

