Exploring engagement and emotional response to realism during simulation-based education

A mixed methods observational cohort study

L GREENE

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A mixed methods observational cohort study

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PROLOGUE

'For the things we have to learn

before we can do them,

we learn by doing them'

(Aristotle, BC 384 – 322)

'I hear and I forget.

I see and I remember.

I do and I understand'

(Confucius, BC 551 – 479)

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ABSTRACT

Introduction: simulation-based education has been used as an innovative technique for healthcare education for over a century. Tools and frameworks are available to guide the design of scenarios, however, techniques used are changing due to digital innovation.

Supporting literature: there are misconceptions associated with simulation fidelity and realism and evidence to investigate the impact of differing variations of realism on learning, engagement, and performance. However, a gap in the literature was identified regarding the effect of varied levels of realism on learner's knowledge, emotions, and behaviours.

Methodology: Bandura's Social Learning Theory was the theoretical framework that guided this research. A research question, study aim, and objectives were generated to explore different simulation-based education scenarios, to discover whether realism had an effect on the quality of the learning experience, leading to enhanced knowledge, and positive emotions and behaviours. Constructionism was the broad philosophical underpinning; symbolic interactionism the theoretical perspective, and a dramaturgical approach was taken to conduct this study.

Methods: an observational cohort study using concurrent embedded design was conducted where the cohort were observed during three different scenarios (Manikin scenario, Human simulated patient scenario and a Paper-case). A feasibility study and pilot study were conducted, with the results used to inform and guide the main research study. Mixed methods were employed; quantitative data to explore the research question and qualitative observational data to provide context and background. Methods included pre- and post-measurement of learner's knowledge and emotions via self-reported questionnaires, baseline self-efficacy measurement, post-intervention realism assessment, plus observation of behaviours using both structured and unstructured participant observation.

Findings: student learners (n=11) from a Pre-registration Masters in Physiotherapy programme participated in the study; n=9 (82%) were female, majority aged 21-30 years (n=7, 64%). There was a difference in realism between simulation modalities – the Human SP scenario was significantly more realistic than the other two modalities (p<0.001). Post-knowledge scores were significantly higher following the Human SP scenario (26/40) and Paper-case (29/40) (p=0.01). Knowledge scores decreased following the scenario with a Manikin (21/40-19/40); this difference was not significant (p=0.6). There was a statistically significant increase in pre/post knowledge following the scenario featuring a Human SP (p=0.01). There was no difference in self-efficacy between the different scenarios (p=0.42); all learners reported high self-efficacy. *Interest* was the strongest pre-scenario positive emotion; *Fear* was the strongest pre-scenario negative emotion. The Manikin scenario caused more negative emotional responses, and the Human Simulated Patient scenario produced more positive emotional responses. Overall, all negative emotions pre- and post-Paper-case were less intense than the other modalities. Six themes were generated from the unstructured observations related to learner's behaviours during each of the three scenarios.

Discussion: The Human SP scenario was perceived to be the most realistic modality; this realism enhanced the learner's experience, producing a significant knowledge gain, positive emotional response, and positive behaviours. The Paper-case was perceived to be the least realistic; however, this did not inhibit the learning experience, as learners gained the highest post-knowledge scores following interaction with the Paper-case, which may be due to the lack of distraction, creating an optimum area for learning. The Manikin scenario was perceived to be not as realistic as the Human SP scenario; it produced negative emotional responses and more negative behaviours; however, manikin-based simulation is necessary in some instances for certain procedural simulation scenarios that may be harmful to a human simulated patient.

Conclusion and recommendations: Considerations are needed when making decisions about the modality and level of realism of simulation-based education prior to the scenario design process. A conceptual framework outlining the interrelationships between systems and subsystems associated with simulation-based education is presented. An appreciation of learner's response to realism should enhance the learning experience and ensure appropriate design and delivery of simulation.

Overview of the Thesis

This thesis is presented in eight chapters. Chapter One comprises a general introduction to the research topic area, historical background, a personal positioning statement, a statement of the problem and justification of the need for the study. Terminology is clarified and selected for use throughout the thesis. Chapter Two consists of a narrative review of relevant literature, positioning the research within the evidence-base. Chapter Three presents the methodological, philosophical, and ethical underpinnings and theoretical framework that supports this work, while Chapter Four describes in detail the methods used to collect the data. Chapters Five and Six outline the quantitative and qualitative findings, respectively. Chapter Seven is a discussion and synthesis of the findings and limitations of the research. Finally, conclusions are drawn in Chapter Eight along with recommendations for policy, practice, and future research. A conceptual framework is presented to conclude the thesis.

CHAPTER 1 - INTRODUCTION

1.0 Chapter overview

This chapter will provide a general introduction to simulation-based education and historical background to set the scene for this study. A spectrum of simulation will be presented, along with techniques for effective scenario design. Finally, a personal positioning statement, to highlight the author's position relative to the research and discussion of the diffusion of innovation, will be discussed and terminology clarified to demystify terms used throughout this thesis.

1.1 Introduction to Simulation-Based Education

Simulation in healthcare is defined as a:

> '…technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion' (Gaba, 2004: i2).

Simulation is not a new teaching strategy; traditionally it has been used as a technique to educate pilots, military personnel, fire, police, and rescue services (Gaba, 2004; Issenberg et al., 2005; Motola et al., 2013). For over a century simulation has been used in medical and healthcare education, in the form of anatomical models, task trainers and role-playing (Good, 2003; Nehring and Lashley, 2009), with the first life-sized manikins produced for practicing clinical nursing skills in 1911 and gaining popularity in the 1950s and 1960s (Good, 2003; Hyland and Hawkins, 2009; Roberts and Greene, 2011). The first manikin to display realistic heart and lung sounds was introduced in 1968 to enhance training for medical and nursing students, interns, and residents (Cooper and Taqueti, 2008). In the 1990s, advances in technology and an increasing demand to improve patient safety and patient care (Gaba, 2004) instigated the development of computer controlled, so-called high fidelity manikin simulators that exhibit realistic physiological responses and represent numerous disease states (Cooper and Taqueti, 2008).

Gaming, computer-assisted instruction, simulated patients, mixed realities, low-tech and high-tech manikins have been introduced to nursing education over the past 70 years (Nehring and Lashley, 2009). During this time, simulation in healthcare has developed significantly. A new paradigm of education in healthcare exists that involves technological innovations to facilitate the delivery of a standardised curriculum (Motola et al., 2013). In 2004, Gaba presented a vision of simulation as a tool to improve patient safety. This paper, *The future vision of simulation in health care*, categorised simulation in healthcare into 11 dimensions (Gaba, 2004) (Table 1-1). Dimension 8 describes the 'Technology applicable or required for simulations' (Gaba, 2004: i4), within which, it was acknowledged that a variety of technologies, including 'no technology', may be relevant to achieve learning goals (Gaba, 2004: i5). In this dimension, verbal simulations (role-play; 'what if' discussions), standardised or simulated patients, part-task trainers (physical; virtual reality), computer patients (computer screen; screen-based virtual world) and electronic patients (replica of clinical site; manikin-based; full virtual reality) are acknowledged as having future relevance in healthcare education (Cooper and Taqueti, 2008; Gaba, 2004). The term 'simulator', when used in healthcare, usually refers to a device that presents a simulated patient or part of a patient, known as a part-task trainer. Conversely, simulated patients are real people, trained using performing arts pedagogy to consistently portray a patient or other individual in a scripted scenario for the purposes of instruction, practice, or evaluation:

> 'A person who has been carefully coached to simulate an actual patient so accurately that the simulation cannot be detected by a skilled clinician' (Lioce et al., 2020: 43).

However, trained simulated people do not always represent the patient; they can also portray the roles of relatives, carers, trainee healthcare students, and qualified healthcare professionals (Nestel et al., 2010). Therefore, more recently, terminology has been adapted to encompass the distinct roles involved during simulation-based education, for example, simulated person:

> '…a person who portrays a patient (simulated patient), family member, or health care provider in order to meet the objectives of the simulation' (Lioce et al., 2020: 43).

Simulated persons may also participate in teaching and assessment and provide feedback to learners. They offer added value for the learners by providing feedback on issues related to patient-centred care; issues that relate to the patients' objectives, or issues that concern the whole person, their emotional needs, and life issues (Stewart, 2001). Simulated patients can be trained to standardise their behaviour during simulation to provide a consistent and accurate performance and behaviour over time and between learners (Wallace et al., 2002; Adamo, 2003). Alternative terms used to describe simulated persons include role-player, clinical teaching associate, trained patient, patient instructor, incognito or unannounced patient, volunteer patient, hybrid patient, actor, and confederate (Nestel and Bearman, 2015).

The advances in accessible technology innovations and simulated person methodology have led to a paradigm shift with technology no longer dictating the design of simulation-based education (Roberts and Greene, 2011). Innovative technologies, such as e-learning, artificial intelligence, mixed realities, and physical simulation with both manikins and trained human simulated patients now enhance traditional teaching and learning techniques, allowing the health and social care workforce to rehearse skills and train more flexibly (Department of Health, 2011). Due to these developments, simulation is now seen as a pedagogy in itself; where situations or environments that allow people to experience a representation of a real event are created (Department of Health, 2011). Furthermore, the Framework for Technology Enhanced Learning presented by the Department of Health in 2011 also states that to improve patient outcomes, safety and experience, simulation should be underpinned by the following six key principles, which guide the design of any innovation:

1. Patient–centred and service-driven
2. Educationally coherent
3. Innovative and evidence-based
4. Deliver high quality educational outcomes
5. Deliver value for money
6. Ensure equity of access and quality of provision

(Department of Health, 2011).

These fundamental principles, although presented over ten years ago, remain appropriate and relevant for current simulation-based education design and delivery.

1.2 Historical background

The first life-sized manikin, Mrs Chase (Figure 1-1), was produced in 1911 for practising clinical nursing skills for Hartford Hospital Training School in Connecticut (Herrmann, 1981). Mrs Chase, the first 'proxy patient' (Grypma, 2012: 181), enabled nursing students to practise skills without ‘inconveniencing or harming patients’ (Grypma, 2012: 181). Baby demonstration dolls were also developed and produced in 1913 for midwifery skills practice (Herrmann, 1981). These life-size manikins gained popularity in the 1950s and 1960s when users realised that they helped students put theories into practice (Hyland and Hawkins, 2009; Roberts and Greene, 2011). Over the last 50 years, the use of simulation and technology in medical and healthcare education has developed significantly, with high-tech manikins used routinely in healthcare education programmes throughout the world.

Figure 1-1: Mrs Chase manikin, produced in 1911
(Image source: Singleton, 2020)

1.2.1 Spectrum of simulation

There is a broad spectrum of simulation (Figure 1-2). At one end of the spectrum are paper-based case studies and video-based simulation, followed by role play, a technique used to educate healthcare professionals for centuries. Procedural Simulation would feature further along the spectrum, and can be defined as:

> ‘The use of a simulation modality (e.g., task trainer, manikin, computer) to assist in the process of learning to complete a technical skill(s) or a procedure, which is a series of steps taken to accomplish an end’ (Lioce et al., 2020: 37; International Nursing Association for Clinical Simulation and Learning (INACSL) Standards Committee, 2021a: 61).

At the other end of the spectrum, one would find fully immersive simulation-based experiences, which comprise 'an array of structured activities that represent actual or potential situations in education and practice' (Lioce et al., 2020: 43; INACSL Standards Committee, 2021a: 62).

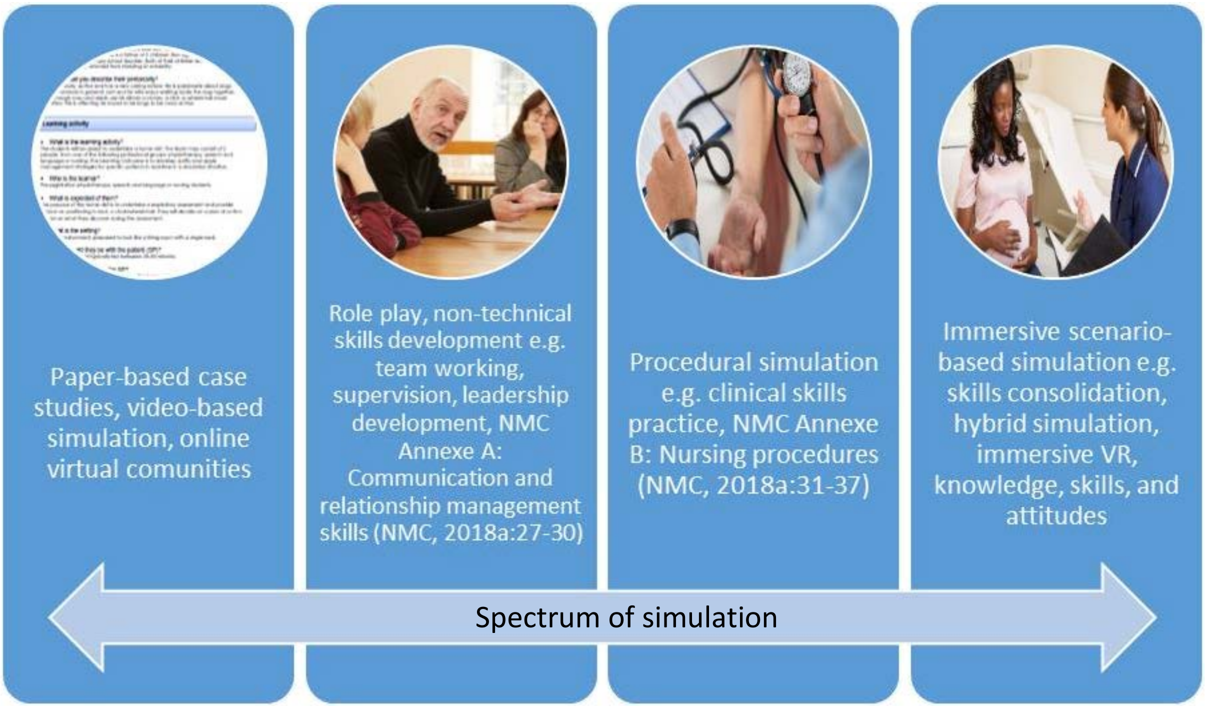


Figure 1-2: Spectrum of simulation (Greene, 2021: 187)

Immersive simulation is designed to allow learners to develop or enhance knowledge, skills, and attitudes in a safe environment whilst responding to realistic situations (Lioce et al., 2020; INACSL Standards Committee, 2021a). Gaba (2004: i3) described a 'rich and complex tapestry of simulation' and referred to eleven dimensions, that can be used to categorise simulation activities in healthcare education (Table 1-1).

Table 1-1: Eleven dimensions of simulation applications (Gaba, 2004)

Dimension 1	The purpose and aims of the simulation activity
Dimension 2	The unit of participation in the simulation
Dimension 3	The experience level of simulation participants
Dimension 4	The health care domain in which the simulation is applied
Dimension 5	The health care disciplines of personnel participating in the simulation
Dimension 6	The type of knowledge, skill, attitudes, or behaviour addressed in simulation
Dimension 7	The age of the patient being simulated
Dimension 8	The technology applicable or required for simulations
Dimension 9	The site of simulation participation
Dimension 10	The extent of direct participation in simulation
Dimension 11	The feedback method accompanying simulation

When choosing the simulation modality, it is important to consider at the forefront, Dimension 1, the learning objectives: 'The purpose and aims of the simulation activity' (Gaba, 2004: i3). Once the learning objectives have been clearly defined, the teaching methods and simulation modality can be refined. It is crucial that the pedagogy leads the use of simulation, rather than the technology (Roberts and Greene, 2011). To be more precise, rather than pedagogy, one should refer to andragogy, the method and practice of teaching adult learners, in this context as healthcare professionals involved in education are adult learners. It is, therefore, the method and practice of teaching adults that should guide the selection of simulation modality. For example, it may be unnecessary to place adult learners into an immersive simulation environment if they are learning an individual skill, for example how to take a person's blood pressure for the first time; this is because a realistic, immersive environment may be too distracting and overwhelming for a novice learner. Practical clinical skills can be practised in a classroom environment using task trainers and simple manikins in silo, prior to learners combining multiple clinical skills in combination with non-technical skills. Alternatively, if the learning objective was to practise non-technical skills, for example, communication, leadership, or team-working skills; role-play would be a beneficial modality. Once the learners have practised, acquired, and rehearsed the required clinical and non-technical skills, these could then be consolidated during an immersive scenario-based simulation.

Immersive simulation can involve human simulated patients, or computer controlled high-tech manikins that exhibit signs and signals or hybrid simulation, where part-task trainers are attached to a simulated patient (Lopreiato et al., 2016; Lioce et al., 2020). As previously mentioned, human simulated patients may also participate in teaching and assessment and provide feedback to learners. Simulated patients can provide valuable feedback to learners on issues related to patient-centredness. Due to the realistic and interactive nature of immersive simulation, it is possible to practise both clinical and non-technical skills in environments where learners are supported, enabled, and encouraged to make decisions and take actions in a safe learning environment that represents realistic healthcare situations (Lioce et al., 2020).

Advances in technology have indicated a shift in the way the future NHS (National Health Service) workforce in the United Kingdom will interact with patients, claiming that engagement with genomics, digital medicine, artificial intelligence, and robotics will change clinical staff roles and function over the next twenty years (Topol, 2019). Topol (2019) further stated that the four healthcare technologies associated with digital medicine that will impact on current models of care are:

- Telemedicine
- Smartphone apps
- Sensors and wearables for diagnostics and remote monitoring
- Virtual reality (VR) and augmented reality (AR)

These innovative technologies will directly impact the future health and social care workforce. Furthermore, the Wachter report (2016) findings suggested that in order to modernise, digitise and transform the NHS, a national strategy, funding, time, and workforce development were required. As a result, we have a responsibility to educate and fully prepare learners to enable them to confidently perform in this changing digital world (Wynn et al., 2023).

Immersive simulation in VR emerged in the 1960's with Ivan Sutherland's 'Sword of Damocles'; the first system to use computer-generated graphics in a head-mounted display (Krevelen, 2007). It had radical features such as head tracking, which made it more immersive than any other system at the time. However, it also had limitations; it was so heavy that it had to be suspended from the ceiling by an adjustable pole. Nowadays, computer-based simulation including virtual patients, VR task trainers, and immersive VR simulation is becoming more accessible, affordable, and common in healthcare education.

In 2004, Gaba predicted that a variety of technologies 'will be relevant for simulation' in the future (Gaba, 2004: i5). Currently, different simulation modalities, such as video-based simulation are accepted methods used for teaching and learning; in particular, non-technical skills or human factors, for example, communication skills, decision-making and team working. Gaba (2004) also commented that complex tasks and experiences can be recreated using technology and education and training on teamwork can be accomplished using videos. To highlight this further in Table 1-1 'Dimension 9: The site of simulation participation' Gaba (2004: i5) explains one of the benefits of using videos, computer programmes, or the Internet for simulation is that it can be experienced in the 'privacy of the learner's home or office using their own personal computer' (Gaba, 2004: i5).

Elaborating on this concept further, it is appropriate to consider how simulation-based education has progressed to include virtual simulation, screen-based simulation, distance, online and remote simulation (Lioce et al., 2020). Online virtual worlds like Second Life® (SL), which was created by Linden Lab and launched in 2003 (Villar, 2022) are available for the purpose of online social activities. Virtual worlds like Second Life® differ from traditional computer games as they do not have a specific goal or endpoint; they have social context and multiple users can engage with each other to take part in social activities or educational opportunities (Aebersold et al., 2012). Whilst the Second Life® platform and its graphics are not classified as advanced compared to current video-game graphics that users experience nowadays, users of Second Life® have reported that the environment was acceptable for 'role play and simulations involving interpersonal interactions' (Aebersold et al., 2012: e471). Some learners also stated that the experience with Second Life® was 'better than or as good as SimMan®' (Aebersold et al., 2012: e473). SimMan, a high-tech simulation manikin launched in 2001 (Singleton, 2020), was seen as an advanced technology used to recreate realistic situations for simulation-based healthcare education. Examples of scenarios that have been developed in Second Life® are family health, disaster preparedness, and home safety (Schaffer et al., 2016) and safety issues with adverse events, difficult inter-professional communications, and priority setting (Aebersold et al., 2012). Evidence suggested that Second Life® was an effective platform for the development of virtual simulation-based learning experiences that are transferrable to real world clinical practice (Aebersold et al., 2012; Tiffany and Hoglund, 2014; Benham-Hutchins and Lall, 2015; Schaffer et al., 2016; Walia et al., 2017). Due to the nature of Second Life®, multiple users are able to interact at the same time and in the same space, which is useful for collaboration, immersive role-playing and real-time interaction including the possibility of using Second Life® for a virtual post-simulation debrief environment for multiple participants. As with all technology, there are barriers and challenges, and these should be considered prior to integration into curricula. However, the future of simulation-based education is changing along with a greater acceptance of virtual, online, and screen-based methods and techniques for simulation.

In addition to video-based simulation, online virtual worlds and physical simulation activities, learners can also benefit from meeting people and experiencing online scenarios via a virtual community like Birley Place (Greene et al., 2020; Wright et al., 2021), which is a similar concept to Second Life®. Virtual communities can be used to explore the complexity of individuals and families; the people and places they encounter help learners to apply complex context to theoretical components of their academic programmes. In the virtual community, learners can meet virtual simulated people and their relatives prior to interacting with them during physical simulation-based experiences. Virtual communities are web-based platforms where learners can access online content whenever and wherever they like, as a prebrief prior to simulation sessions or as a re-cap, for post-event reflections following on from simulation post-debrief (Greene et al., 2020; Wright et al., 2021).

1.2.2 Scenario design

The key to ensuring effective learning during simulation is defining achievable learning objectives from the outset. By using well-designed and constructed scenarios, one can ensure that the learners, facilitators, simulated persons, and technical colleagues are properly prepared and supported throughout the simulation, from induction to prebrief and beyond the scenario itself, during the debrief and post-event reflection activities. Frameworks and proformas exist to assist with scenario design. Jeffries (2005) proposed a framework for designing, implementing, and evaluating simulations in nursing. This framework includes 'five major components with associated variables' (Jeffries, 2005: 97) the components are Teacher Factors, Student Factors, Educational Practices, Simulation Design and Outcomes (Jeffries, 2005). Jeffries original (2005) framework has been adapted and is now known as the National League for Nursing (NLN) Jeffries Simulation Theory (2015). The NLN Jeffries Simulation Theory concepts have been updated and now include Context, Background, Design, Simulation Experience, Facilitator and Educational Strategies, Participant, and Outcomes, which provide a structured theory to guide the design of simulations for nursing education. Another framework, the Integrated Simulation and Technology Enhanced Learning (ISTEL) framework (Gough et al., 2016a) integrates three distinct but interlinking, components, which guide scenario design, development, implementation, evaluation and research around simulation and technology enhanced learning (STEL). These three components include Preparation, Intervention, and Evaluation/research. The three components are further sub-divided into seven elements: 1. Learner; 2. Facilitator; 3. Theory and educational practices; 4. Learning design characteristics; 5. Prebrief and debrief; 6. Linked learning activities; and 7. Outcomes. The ISTEL framework can be used as a guide to enable users to properly prepare to undertake simulation-based education:

> 'The ISTEL framework emphasizes the importance of ensuring appropriate theoretical and educational practices underpin the design, preparation, implementation and evaluation of STEL interventions; whether this be for a scenario, short course or embedded within healthcare curricula' (Gough et al., 2016b: e28).

The ISTEL framework is advocated for the design, development, and evaluation of, or research associated with simulation and technology enhanced learning in physiotherapy and other healthcare disciplines (Gough et al., 2016a).

Another example of a framework that can be used to aid the design of effective scenarios is the INACSL Standard of Best Practice: Simulation Design (INACSL Standards Committee, 2021b), which outlines eleven criteria for effective Simulation Design. They state that simulation-based experiences should be designed to meet identified learning objectives, which will optimise the achievement of expected outcomes and, as a result, strengthen the overall value of the simulation-based experience (INACSL Standards Committee, 2021b). The eleven criteria for simulation design are depicted in Figure 1-3. The eleven INACSL Simulation Design criteria can be adapted to provide a practical template or checklist to ensure that simulation is well designed.

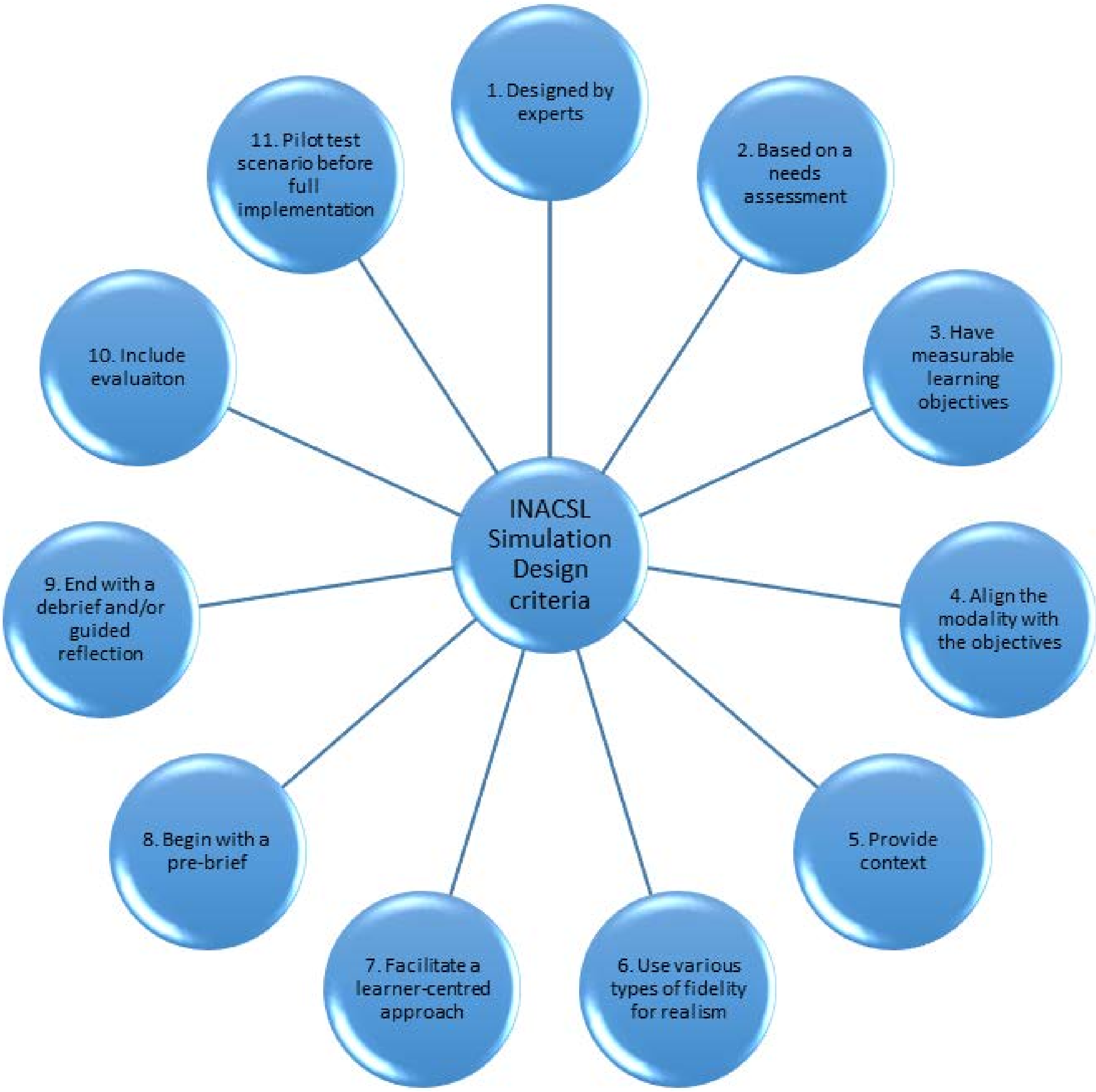


Figure 1-3: INACSL criteria for effective simulation design

Further evidence-based scenario design templates are available for educators to use that standardise the design process. These templates are often produced by manikin companies to aid the development of programming computer-based manikins, for example, CAE Healthcare's simulated clinical experience (SCE) and associated patient development form (CAE Healthcare, 2012a, 2012b) or Laerdal's scenario design template (Laerdal Medical, 2009). However, these scenario development tools can assist with the development of superior quality materials, irrespective of the simulation modality, whether this be video-based simulation, role-play, procedural or immersive simulation.

In the north of England, facilitators and academics have access to three regional simulation networks hosted by NHS England (formerly known as NHS Health Education England, HEE). These are located in the North East, North West, and Yorkshire and Humber, together forming the North Simulation Group (NHS HEE, 2022). Other regions in the United Kingdom do not have regional simulation networks, however, they are supported by regional technology enhanced learning (TEL) forums (NHS HEE, 2022). In the North West, we are fortunate to have access to a supportive, vibrant network of experts who have developed a shared simulation scenario library containing over 200 peer-reviewed scenarios and a helpful process of mentoring and sharing best practice in the region. Members of the North West Simulation Education Network (NWSEN) also have access to e-learning and face-to face training and an accreditation programme provided by NWSEN. Furthermore, NWSEN developed a scenario design simulation proforma template, based on best practice, which guides the user through the essential steps to enable them to produce effective simulation scenarios. Once designed on the proforma, scenarios can then be submitted for peer-review and uploaded onto the shared scenario library. The NWSEN proforma (Figure 1-4) is a standardised template which, when complete, ensures the scenario is designed correctly:

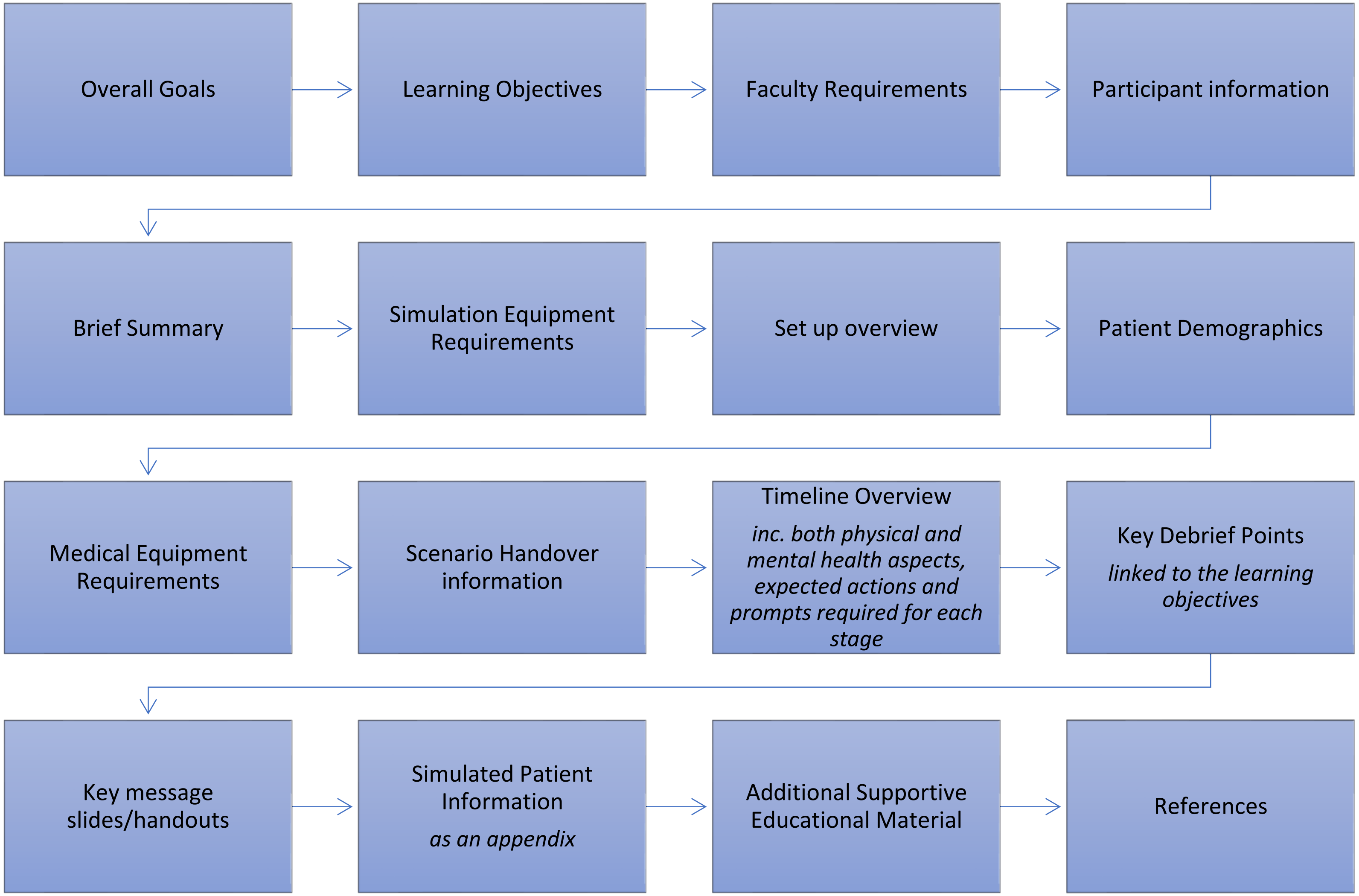


Figure 1-4: Specific sections of the NWSEN simulation proforma

When designing any new simulation-based education activities, regardless of the modality, the ISTEL Framework, the eleven INACSL Simulation Design criteria and the above sections from the NWSEN proforma may be considered to support high quality simulation-based education design and delivery.

1.3 Personal positioning statement

As a child, I knew one thing for sure, that I wanted to be 'a scientist'. As an undergraduate, I studied biochemistry and positioned myself firmly as an empirical scientist, graduating with a specific interest in, and experience of, haematology. After graduation, my first career was as a quality control scientist in a pharmaceutical company, specifically working on the nasal flu vaccine. It was everything I had dreamed of, but transpired to be a very isolated, lonely career choice. Considering myself a 'people-person' I moved into a career in higher education, working as a Technician/Demonstrator and using my scientific knowledge and background to develop experiments and support students in Psychology and Health Sciences. I took every opportunity to improve myself and enhance my own knowledge and quickly branched out into leading seminars for Biological Psychology. I studied part-time for a Masters in Research (MRes) in Health and Social Care and this was a real turning-point for me personally as I developed a deeper understanding and appreciation of other philosophical and theoretical viewpoints and social research methods. Over the years, I studied and researched more and progressed steadily into an academic career. As an educationalist, I have always considered myself to be creative, and have never shied away from, or hesitated to use novel, innovative methods, and techniques. At work I am an innovator and an early adopter (Rogers, 1995); a technical, practical person, with a proactive attitude. If things go wrong, that is ok, we learn by experience and reflect, improve, develop, and grow as a result. Philosophically I now consider myself a post-positivist, rational empiricist, believing in both induction, deduction, *and* experience to gain knowledge. This is highlighted in my Myers-Briggs personality type (Extroverted-Intuitive-Thinking-Judging, ENTJ) (The Myers-Briggs Company, 2023) and accounts for my deep religious beliefs and contradictory pragmatism. However, fundamentally I am a daughter, sister, wife, mother, and friend. I am compassionate, caring, empathetic, sympathetic, and highly protective. My vision is to excel and be the very best I can be in every aspect of my life. My education and life experiences have informed this thesis, which is positioned, and based on, my personal, professional, and philosophical view of the world.

1.4 Statement of the problem and need for this study

When considering simulation-based education, it is a non-traditional method of teaching and learning, one that can be seen as technical, immersive, practical, active, and experiential. Creativity is the ability to invent and develop original ideas, whereas to innovate means to make changes in something that already exists, especially by introducing new methods, ideas, or products. Simulation-based education can be seen as both a creative and innovative pedagogy. Nevertheless, innovation is not easy; it requires time, resources, and devotion. The rate of adoption of any innovation can be slow due to the perceived characteristics of the innovation itself, pre-conceptions, subjective evaluations, and personal experiences (Rogers, 1995). *So why do we do it*? Traditional teaching and learning methods of didactic teaching, rote learning and behaviourism do not encourage students to become active participants in the learning process. Using theories and methods such as learning by doing (Gibbs, 1988), action-learning (Revans, 1980) situated learning (Lave and Wenger, 1991), experiential education (Dewey, 1938; Piaget and Cook, 1952; Rogers, 1969), experiential learning and learning through reflection on doing (Kolb, 1984) generates creative minds through social action and interaction. In the late 1600's John Locke discussed truth and knowledge, claiming that they arise out of observation and experience, rather than manipulation of accepted or given ideas (Gay, 1964). However, earlier still, Aristotle and Confucius were aware of the same concepts, which we now utilise on a daily basis in medical and healthcare education: they stated, 'For the things we have to learn before we can do them, we learn by doing them' (Aristotle, BC 384 – 322) and 'I hear and I forget. I see and I remember. I do and I understand' (Confucius, BC 551 – 479). Confucius also said that we learn 'wisdom' by three methods: first, by reflection, which is noblest; second, by imitation, which is easiest; and third by experience, which is the bitterest. *Do we want our teaching and learning to be noble, easy, or bitter*? Ultimately, the aim of this thesis is to use the knowledge gained to guide future educationists and 'simulationists' (Kardong-Edgren, 2013: e561; Park et al., 2018), to enable them to confidently select appropriate modalities, methods and techniques that encourage learners to develop knowledge, skills and attitudes that will impact on their future healthcare practice, with the long-term goal of improving patient safety.

In 2020, the COVID-19 pandemic began. By March of that year, the United Kingdom entered a full lockdown, the first of many. While the world stood still and waited for the pandemic to pass, healthcare professionals, key workers, teachers, and academics pressed on to provide essential health and social care, food supplies and education. This was a turning point for many. Although it was a challenging time personally, fraught with competing demands, my own personal experience was a positive one. It allowed me to spend precious valuable time with my young family and reconnect with them in so many ways. Professionally, too, the experience was constructive. My colleagues began to understand the concepts that I had been describing for many years around online and virtual learning; simulation, e-learning and technology-enhanced learning suddenly became and essential commodity, rather than a challenge to overcome. And I was ready, ahead of the curve to put into practice a switch from the physical to virtual world of simulation-based education, utilising methods of teaching and learning that the late majority and laggards[1] (Rogers, 1995) had previously dismissed. There was a noticeable acceptance and shift in the diffusion of innovation curve (Figure 1-5), due to the pandemic. My task now is keeping momentum, to ensure that these innovations remain in place post-pandemic. My goal is to act as an agent for change (Rogers, 1995; Kaminski 2011); someone who can influence the late majority and the laggards; to mix up the status quo and serve as a role model to revolutionise simulation-based education for the future.

Too often in the past I witnessed learners' experience poorly prepared and executed simulation activities, delivered with little planning, no learning objectives and with insufficient or no time dedicated for reflection and debrief. I have observed learners set-up to fail, allowed to carry out tasks incorrectly, with no support and little prior knowledge or experience who become crushed and defeated as a result. I have seen a learner flee from the simulation room and lock themself crying in the bathroom, overwhelmed and too upset

[1] The term laggard can be seen as pejorative; however, it is not my intention to use this term in a derogatory way. Laggards/late adopters are often more reflective when considering new approaches or innovations.

to return to the session. I have watched with realisation that automatonophobia[2] does exist, and I have coached and supported learners through periods of cognitive behavioural therapy (CBT) treatments to overcome this phobia. I have dedicated the last fourteen years of my working career to supporting learners, protecting them from negative experiences and providing safe spaces for them to learn experientially. I have designed and led a successful PGCert in Simulation and Technology Enhanced Learning (STEL) with the aim to educate other simulationists in the theoretical underpinnings and practical application of STEL in healthcare, to enable them to learn how to conduct simulation successfully. I recognise that learners need to be introduced thoroughly to the environment and the equipment, they need to have clear guidelines and an appreciation of what is expected of them. The instructional design of scenarios is paramount to successful simulation-based learning experiences, and I have delivered regional masterclasses on how to design effective scenarios. Along with an International team of researchers, I developed a training programme for simulated patients (SPs) and simulated patient trainers (SPTs) plus a Simulated Patient Common Framework[3] (Gough et al., 2015) to protect people involved in simulation from being exploited. The SP Common Framework provides guidance on resource considerations, recruitment and selection, training requirements, risk assessments and quality assurance procedures (Greene and Gough, 2016). I deliver the SP Programme training on behalf of NHS England (formerly Health Education England in the North West). This thesis is a culmination of these years of work. It is an investigation to discover whether what I do is effective; to appraise different modalities of simulation, the resources I have created and the practical methods I use to introduce learners to simulation. The intention is to share this new knowledge with a view to prevent poor practices from the past from reoccurring in the future.

1.5 Adoption of innovation

Diffusion of innovation is the process whereby an innovation is articulated and shared over time with members of the social system (Rogers, 1995). Bandura (1977a) also discussed

[2] Automatonophobia: the fear of human-like figures, including manikins
[3] SP Common Framework and Checklist available [Online] here: https://www.ewin.nhs.uk/sites/default/files/SP%20Common%20Framework%20and%20Checklist_Poster.pdf (ewin.nhs.uk)

diffusion of innovation in relation to Social Learning Theory (SLT), he stated that social diffusion of innovation is determined by two factors: acquisition of innovative behaviours and the adoption of innovation in practice (Bandura, 1977a).

Simulation-based education is both a creative and innovative method of teaching and learning (Chapter 3, Section 3.3.1). New ideas, as with any innovation, or 'social change' (Rogers, 1995: 6) are either adopted or rejected. Adoption of the innovation takes place via communication over time within the social system. The social system, in the context of this study, is healthcare education. Simulation-based education has been accepted by the social system and it is now the norm for higher education institutions and hospitals to use simulation-based education for basic and advanced skills training (Good, 2003).

There is an expectation that healthcare education is delivered using innovative techniques, including practical methods, simulation, virtual, online and distance learning (Lioce et al., 2020), rather than solely traditional lecture-based didactic approaches. The diffusion of innovation for simulation-based education has been a slow process. The 'innovation-decision process' (Rogers, 1995: 20) has five main steps: Firstly, Knowledge, secondly Persuasion, third, Decision, fourth, Implementation and lastly, Confirmation (Rogers, 1995). Innovations are adopted at different rates depending on people's requirements and other factors including finances, skills, and resources (Bandura, 1977a). These social and economic factors regulate people's behaviours and impact the rate of diffusion, hence as simulation is considered to be both resource and equipment intensive and therefore expensive (Good, 2003), the uptake has been gradual yet slow. The diffusion of innovation curve can be plotted over time and represents a bell-shaped curve, with distribution segmented into categories called Innovators, Early adopters, Early majority, Late adopters/late majority, and Laggards (Bandura, 1977a; Rogers, 1995). The adoption of any innovation is related to individual's personal characteristics, plus their social and economic circumstances (Bandura, 1977a), with late majority/late adopters and laggards, waiting to see the benefits gained by the innovators before adopting the innovation themselves.

The Covid-19 pandemic shifted the innovation curve, with late majority/late adopters and laggards, traditionally occupying fifty percent of the last people to adopt an innovation

(Rogers, 1995). These late majority/late adopters and laggards, however during the pandemic, had no choice but to adapt their views and adopt the innovation-decision process at a much faster rate, as access to physical space and traditional techniques were unavailable (Figure 1-5). The variables determining the rate of adoption had changed due to the nature of the social system (Rogers, 1995), meaning that innovators were called upon to make rapid changes and suggestions for innovative techniques to overcome barriers in access to traditional teaching and learning methods, which were accepted by all.

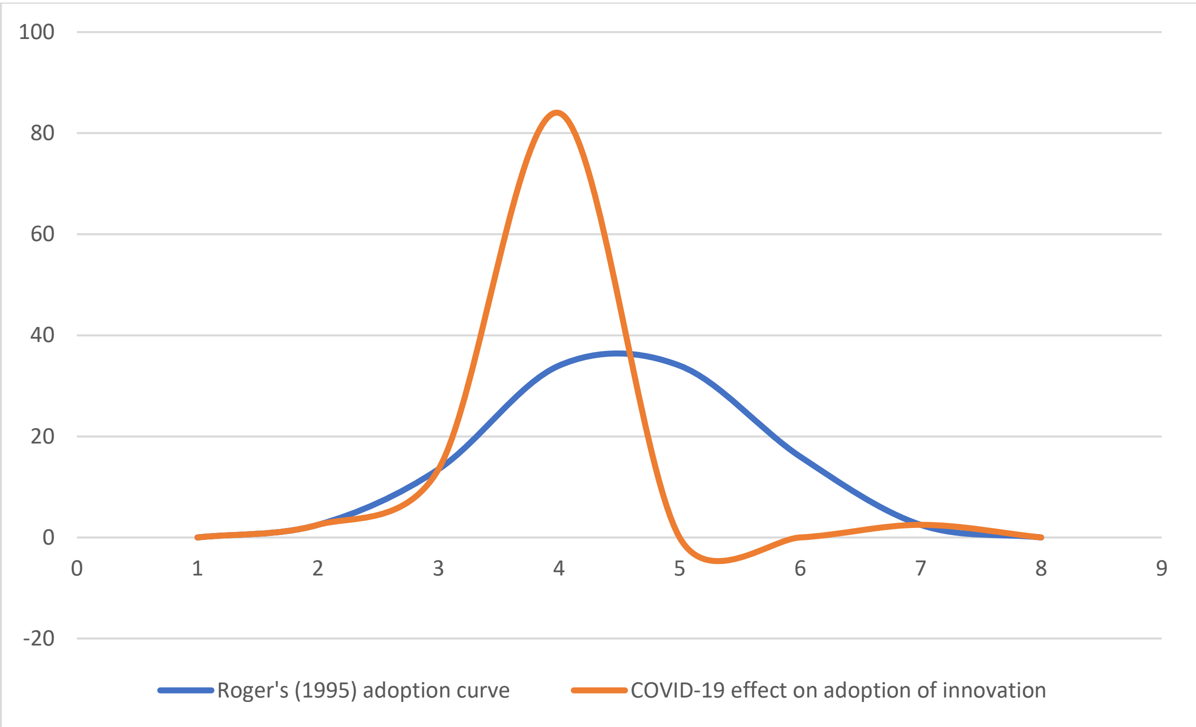


Figure 1-5: Adapted diffusion of innovation curve due to Covid-19 pandemic

Following the Covid-19 pandemic, and based on evidence from simulation-based education and practice (Ahmady et al., 2021; Alves Bastos e Castro and Lucchetti, 2020; Pears et al., 2020), the Nursing and Midwifery Council (NMC) announced that simulated practice learning (SPL) could be delivered using 'alternative contemporary approaches' including:

> '…simulation, virtually and digitally, and include peer learning; actors; high and low fidelity including manikins/environments; and virtual and online practice learning training programmes involving authentic case studies, reflection, and interaction with people' (NMC, 2022: 7).

Similarly, the Health and Care Professions Council (HCPC) (2021) also announced that:

> 'Education providers have flexibility to consider using simulation where they feel it can be meaningfully applied to deliver a quality practice-based learning experience' (HCPC, 2021, online).

Unlike the NMC, who state that approved education institutions (AEIs) can utilise up to 600 hours of SPL in their programme, the HCPC do not prescribe how and where practice-based learning must take place, nor do they specify a core number of hours to be delivered using innovative techniques. They do, however, acknowledge that practice-based learning delivered by education institutions must ensure quality and maintain standards[4] (HCPC, 2021). This was a vast change from the traditional view that practice-based learning had to occur whilst on practice placement and opened doors for utilising more innovative techniques for healthcare education.

1.6 Terminology

The terminology used to describe simulation, fidelity, realism, and authenticity has caused much debate over the years (Rudolph et al., 2007; Hamstra et al., 2014; Tun et al., 2015; Stokes-Parish et al., 2017). The glossary of terms included in Appendix A includes relevant terms and definitions to clarify any confusion. The second edition of the Healthcare Simulation Dictionary (Lioce et al., 2020) has been utilised to ensure terms are applied and cited correctly. Throughout this thesis I have used the term *manikin* to describe a life-sized human-like simulator. The term *simulated person* is used to describe all people involved in simulation activities, including simulated relatives and simulated healthcare professionals. S*imulated patient* is used specifically to describe a human trained to take on the role of a patient during simulation scenarios. I have rejected the use of the terms *high fidelity*, *mid-level,* and *low fidelity* as these are subjective, considered outdated and have been identified as potentially controversial (Hamstra et al., 2014; Lopreiato et al., 2016). Instead, I have used the terms *high-tech* to describe computer-controlled human-like manikins and *procedural* or *immersive* to describe simulation modalities, with reference to the spectrum of simulation (Figure 1-2). *Realism* is used to describe how accurately or true-to-life the

[4] HCPC Standards, available here: https://www.hcpc-uk.org/standards/

situation was. During this thesis I refer to, and explore, the level of realism of different simulation modalities and its effect on learner's engagement and emotional response during simulation-based learning experiences.

1.7 Chapter summary

In this chapter, an introduction to simulation-based education was presented along with an historical background outlining the developments in simulation-based education over the past century. The Spectrum of Simulation (Greene, 2021: 187) was illustrated to describe different simulation modalities ranging from paper-based case studies to fully immersive simulation scenarios. Scenario design tools and templates were discussed along with recommendations of how to design appropriate scenarios to benefit the learners. Next, a personal positioning statement and statement of need for this research was included, outlining the creative and innovative nature of simulation-based education. Finally, terminology was clarified and an acknowledgement of the speed with which innovative simulation-based education techniques have been adopted over the last few years and the impact this has had on the social landscape in which this research is based was also presented. A narrative literature review follows in Chapter Two, which identifies gaps in the body of knowledge and further highlights the need for this research project.

CHAPTER 2 - LITERATURE REVIEW

2.0 Chapter overview

A narrative review of the literature related to this research into simulation-based education has been conducted. The purpose of this review was to critique, summarise and draw conclusions about the topic. This review has identified gaps in the body of knowledge and highlights the need for this research project.

2.1 Background

Advances in technology have led to new and innovative simulations and more complex scenario design, which has subsequently resulted in studies to investigate and measure simulation effectiveness (Cordi et al., 2012; Leighton et al., 2015). In 2005, the Best Evidence Medical Education (BEME) systematic review (Issenberg et al., 2005) revealed features of 'high-fidelity' medical simulations that lead to effective learning and in 2013 Motola et al. published the Association for Medical Education in Europe (AMEE) Simulation in Healthcare Education Best Evidence Practical Guide. The International Nursing Association for Clinical Simulation and Learning (INACSL) Standards Committee published the INACSL Standards of Best Practice in 2011, which were then revised in 2016 as the Standards of Best Practice for Simulation (INACSL Standards Committee, 2016a), with the intention of advancing the science of simulation, to share best practices, and provide evidence-based guidelines for implementation and training (INACSL Standards Committee, 2016b). In the same year, Lopreiato et al. (2016) published the Healthcare Simulation Dictionary to compile terms and provide a taxonomy to enhance communication and clarity for healthcare simulationists.

The INACSL Standards have since been updated and re-released in 2021 and are now known as the Healthcare Simulation Standards of Best Practice™. They include individual standards for Professional Integrity, Professional Development, Simulation Design, Outcomes and Objectives, Prebriefing: Preparation and Briefing, Facilitation, The Debriefing Process, Evaluation of Learning and Performance, Operations, Simulation-Enhanced Interprofessional Education, and a Simulation Glossary (INACSL Standards Committee, 2021c, 2021d). Furthermore, the Healthcare Simulation Dictionary second edition was released in 2020 and updated to include terminology related to simulation at a distance, including online, remote, and virtual simulation (Lioce et al., 2020). This plethora of information has led to healthy debate within the healthcare simulation community, in particular around the terms used to describe and define simulation and the effectiveness of different 'levels' of simulation.

During healthcare simulation, learners are expected to act in the same way as they would in a real healthcare situation. However, learners often struggle with the complexities of simulation and can become anxious and uncomfortable when performing in front of their peers (Nehring and Lashley, 2004; Garrow, 2014; Miller, 2019). Facilitators aim to support learning in a safe environment, with the intention of increasing confidence and competence by deliberate and repeated practice (Department of Health, 2011). It has been found that both the effectiveness of simulation and learners' experience increases proportionately as the precision of the replication of the real world improves (Hays and Singer, 1989; Salas and Burke, 2002; Dieckmann et al., 2007). With this in mind, it could be considered that a perfectly realistic simulation then becomes the gold standard (Dieckmann et al., 2007). However, it is unclear in the literature, which terms one should be using, and, more importantly, the emotional impact that immersing learners in truly realistic scenarios has on their ability to learn, engage, and perform during simulation. The following sections will attempt to clarify and define some of the terms associated with healthcare simulation, in particular, realism and fidelity. Misconceptions associated with these terms and the variations in simulation realism will then be discussed, followed by a consideration of the impact of different simulation modalities on learning, engagement, and performance. Lastly an exploration of new concepts in simulation realism will be outlined.

2.2 Search strategy

A search of the literature was conducted over a 20-year period from 1997 to 2017[5]. The following databases (AMED (The Allied and Complementary Medicine Database), APA PsychArticles, APA PsychInfo, British Education Index, CINAHL, Education Abstracts, ERIC (Education Resource Information Center), Library Information Science & Technology

[5] Phase 1 literature searches occurred in 2017, this search was further screened to included papers from the last ten years (2007-2017). This body of literature informed my narrative review, my main research study, and the data collection process, which occurred in 2017. Phase 2 literature searches occurred in 2022, to include updated standards, best practice (INACSL, 2021a-f) and terminology (Lioce et al., 2020).

Abstracts and MEDLINE) were searched using the search terms ‘simulation training OR simulation education OR simulation learning’ AND ‘realism’. The search results are detailed in Figure 2-1.

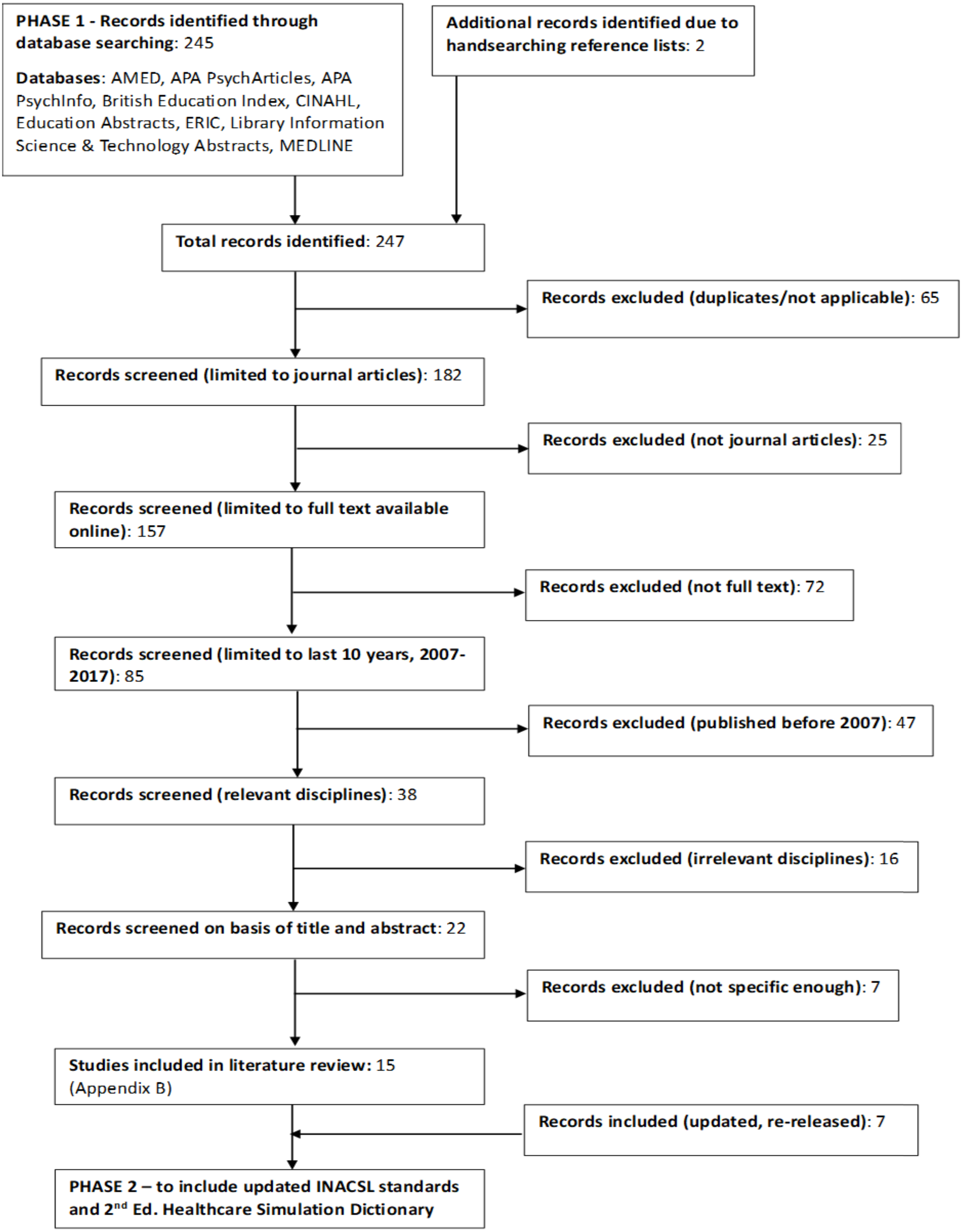


Figure 2-1: Search strategy and results

Grant and Booth (2009) detailed a topology of fourteen review types and associated methodologies. They stated that narrative reviews seek to 'identify what has been accomplished previously, allowing for consolidation' (Grant and Booth, 2009: 97) they also claim that narrative reviews are useful for building on previous work and identifying gaps in the literature (Grant and Booth, 2009). A narrative review was selected for this research study to provide a comprehensive overview of the concept of simulation realism and to explore alternative modalities used in simulation. The purpose of the literature review was to identify gaps in the literature prior to identifying the research question and designing the study. There are limitations of conducting a narrative review, for example, there is a lack of explicit intent as would be found in a systematic review, and any data identified is not analysed as would occur in a meta-analysis. Furthermore, conclusions drawn can be subject to bias if, for example, literature is inadvertently excluded. It is also acknowledged that literature may have been specifically selected that supports my worldview. However, the limitations of a narrative review, whilst acknowledged, do not outweigh the benefits of a well-structured, detailed narrative on the topic of interest to provide a comprehensive overview. The fifteen papers detailed in the following narrative review are tabulated in Appendix B.

2.3 Defining the concept of realism in simulation-based healthcare education

The available body of literature discussing simulation-based healthcare education includes differences in the terminology used to describe realism in simulation. The terms *fidelity* and *realism* are often used interchangeably, and both terms are frequently used to describe *authenticity*. Fidelity is described as 'believability, or the degree to which a simulated experience approaches reality' for the learner (INACSL Standards Committee, 2016b: S42), however, the term fidelity has been removed from the updated Simulation Glossary (INACSL Standards Committee, 2021a). The authors also proposed that; 'as fidelity increases, realism increases' (INACSL Standards Committee, 2016b: S42), which suggested a positive correlation between the two concepts. Simulation fidelity has been used as a mechanism to describe the realism learners experience in simulation, with the Healthcare Simulation Dictionary (Lopreiato et al., 2016; Lioce at al., 2020) providing definitions for the terms 'Conceptual fidelity', 'Environmental fidelity', 'Fidelity', 'Functional fidelity', 'High-fidelity simulator', 'High-fidelity simulation', 'Low-fidelity', 'Physical fidelity', 'Psychological fidelity' and 'Simulation fidelity' as well as 'Realism'. Clearly there is the potential for confusion around the terms *fidelity* and *realism* that authors have sought to clarify (Tun et al., 2015; Hamstra et al., 2014; Dieckmann et al., 2007; Rudolph et al., 2007; and Schaumberg, 2015). Others have designed scales to measure and quantify realism; The German VR Simulation Realism Scale consists of items relating to one of four subscales: scene realism, audience behaviour, audience appearance and sound realism (Poeschl and Doering, 2013). The scoring of 1 (totally disagree) to 5 (totally agree) results in a maximum high realism score of 70 (Poeschl and Doering, 2013). Whist it is now possible to quantify realism, there are still conflicting definitions and differences of opinion associated with the concept of realism.

Dieckmann et al. (2007) presented a 'Concepts and Commentary' referring to simulation education as a social practice. Social practice as a theory suggests a link between practice and context; where a social activity occurs, it is possible to identify its main cause and associated outcomes (Herndl and Nahrwold, 2000). In an attempt to provide conceptual clarity about simulation realism and related terms, Dieckmann et al. (2007) introduced three theoretical concepts, applying them to simulation-based healthcare education and training. The three concepts are:

- Modes of thinking to describe simulation realism
- Primary frames and modulations
- The 'as if' concept

Dieckmann et al. (2007) described three modes of thinking about simulation realism: physical, semantical, and phenomenal. The physical mode concentrates on things that can be measured and refers to the physical characteristics of equipment and simulators. The semantical mode is concerned with concepts, theories, meaning and information. The phenomenal mode is related to emotions, beliefs, and cognitive states of rational thought that learners experience during simulation. The authors stated that 'scenarios can be semantically realistic if the information presented is reasonably interpretable even if the physical basis to transport the information is not realistic' (Dieckmann et al., 2007: 184). Furthermore, the authors noted that learners will be able to accept phenomenal, physical, and semantical differences in simulation settings, as long as they understand how the simulation is related to clinical practice. Dieckmann et al. (2007) also stated that it is more cost-effective to minimise the physical fidelity and maximise the semantic and phenomenal modes in scenarios.

Primary frames are used in Dieckmann et al.'s (2007) paper as a way of describing the cognitive structures that learners use to make sense of the situation during simulation. The primary frame is the clinical case on which a simulation is based; it is important as it guides the components of the simulation that the learners interpret as relevant, and the actions that they take as a result. Primary frames are individual and can be both natural (related to the laws of chemistry, biology, anatomy, and physiology) and social (related to decision-making, motivation, goals, and interactions). In simulation both natural and social primary frames are useful and important for adding complexity to scenarios:

> '...primary frames, both natural and social, might be active in parallel in any given situation, accounting for the complexity of both actual cases and simulation scenarios' (Dieckmann et al., 2007: 187).

Furthermore, natural, and social primary frames should be considered from all three modes of thinking (physical, semantical, and phenomenal):

> 'Consider an interaction in a leadership situation. Physical aspects (e.g., facing each other or not, or the audibility of speech volume) are correlated to semantical aspects (seeing each other's responses, or ability to hear and interpret the others' utterances) and then to phenomenal aspects (feeling listened to or feeling part of a team)' (Dieckmann et al., 2007: 187).

A modulation is the simulated variation of a primary frame. Aspects of the modulation (simulation) must be previously defined in the primary frame, (or it would be a new primary frame); this ensures that simulation scenarios are easy for learners to understand and ensures they do not feel 'duped' (Dieckmann et al., 2007: 188). The authors also stated that it is important for simulation facilitators to ensure that learners know why and how they are involved in simulation by outlining the 'rules' of the scenario (Dieckmann et al., 2007: 188); facilitators must introduce the characters, 'who is who and what role they are enacting' (Dieckmann et al., 2007: 188) to allow learners to be better able to suspend disbelief. By outlining the rules of the scenario and introducing characters, the intended flow of the scenario is enhanced, and learning is optimised.

The *as-if* concept (Vaihinger, 1927) describes the intention of simulation to enable learners to treat the simulated situation presented 'as if' it was real (Dieckmann et al., 2007: 188). Dieckmann et al. (2007) claimed that the 'as-if' concept allows for greater semantical and phenomenal realism, even if the physical realism is distinctly different from the real thing:

> 'For simulation to be effective, participants should either willingly accept this 'as-if' character and where necessary suspend disbelief…or they can acknowledge and accept the artificial character of simulation and the differences from the clinical setting while still seeing the relevance of the exercise for its stated pedagogical goal' (Dieckmann et al., 2007: 189).

Dieckmann et al. (2007) warned that placing too much emphasis on the physical realism of a simulation can be detrimental to the simulation as a whole. They recommended that facilitators should use social elements, for example, providing hints, feedback and help during simulation. Encouraging learners to suspend disbelief and engage with a 'fiction contract' (Dieckmann et al., 2007: 189), therefore acknowledges that the physical characteristics of the simulator are less important for learning to take place in simulation:

> 'If participants, due to social influences, are not willing to suspend disbelief and do not engage into a 'fiction contract', there is no way that the physical characteristics of the simulator can make them change their mind' (Dieckmann et al., 2007: 189).

In 2007, Rudolph et al. published 'Which reality matters? Questions on the path to high engagement in healthcare simulation'. This editorial supported and added clarity to Dieckmann et al.'s (2007) work, highlighting the concepts and discussing other aspects of simulation that influence learner engagement with simulation. Rudolph et al. (2007) aimed to simplify two of the terms used by Dieckmann et al. (2007) to define the modes of thinking about simulation realism by suggesting the term 'conceptual mode' instead of semantical and 'emotional and experiential mode' instead of phenomenal (Rudolph et al., 2007: 162). In this paper, Rudolph et al. (2007) discussed physical realism, agreeing with Dieckmann et al. (2007) that it is not physical realism, but rather the emotional and experiential experience that allows learners to act and feel *as if* the simulation were real. Building on Dieckmann et al.'s (2007) work, Rudolph et al. (2007) claimed that learners must experience the simulation emotionally and experientially, in order to make conceptual sense of the simulation, even though the physical realism may be different from the real clinical situation. Blending of the three modes of thinking about simulation realism can be beneficial to enable learners to suspend disbelief and engage with a 'fiction contract' (Rudolph et al., 2007: 162). They also advocated using the term *fiction contract* rather than *suspend disbelief* as a fiction contract implies that 'engagement in simulation is a contract between the designer and instructor with the learner' (Rudolph et al., 2007: 162), which will enhance the learner buy-in during simulation. They state that a successful scenario is not based on the realism of the simulation, but instead the ability of learners to step into a role, connect with others in the scenario and link their learning to previous social, clinical, and psychological experiences (Rudolph et al., 2007). Establishing a fiction contract and gradually enticing learners into the scenario enhances engagement and, therefore, learning:

> 'A well-designed scenario gradually 'draws people in' such that they are increasingly engaged, and no single element of realism violates their expectations in a way that disrupts the engagement' (Rudolph et al., 2007: 162).

In 2017, Stokes-Parish et al. explored engagement, authenticity, and realism theories in the context of moulage, which is the application of special effects or makeup techniques to manikins and simulated patients in simulation-based education (Stokes-Parish et al., 2017). In this paper, they use the same definition of realism as quoted by Dieckmann et al. (2007) and Lopreiato et al. (2016) in the Healthcare Simulation Dictionary. Stokes-Parish et al., (2017) also clarify Dieckmann et al.'s (2007) modes of thinking in three realism characteristics: Physical (actions); Semantical (theories and concepts); and Phenomenal (thoughts, emotions, and beliefs). The body of work by Rudolph et al. (2007) and, more recently Stokes-Parish et al. (2017) further highlights the growing acceptance of realism as a concept in itself with multiple characteristics.

In 2003, a study by Hall aimed to conceptualise media realism, which is 'the way in which media representation is seen to relate to real-world experience' (Hall, 2003: 624). Three research questions were addressed to discover firstly, how audiences' perceived media realism; secondly, how audiences' understandings of realism agree with, or differ from, the conceptualisations that have been developed by researchers; and finally, if audiences' use more than one conceptualisation of media realism, when these different conceptualisations are more likely to be used. Forty-seven young adults took part in semi-structured focus groups to discover the nature and characteristics of realistic and unrealistic media (films and television programmes). Hall (2003) discovered that realism was seen as multi-dimensional, and then sought to identify the different components of realism. Hall (2003) found that, in some media examples, the portrayal of emotions of the character could be realistic, but the plot and situations they find themselves in may not be realistic. This study revealed six distinct methods of evaluating media realism: plausibility, typicality (representativeness), factuality, emotional involvement, narrative consistency, and perceptual persuasiveness. These terms are described in Table 2-1 below:

Table 2-1: Six distinct methods of evaluating media realism (Hall, 2003)

Plausibility	A realistic media portrayal is one that represents events or behaviours that have the potential to occur in the real world
Typicality	The representation of events or characteristics that are common among a particular population. Something must be plausible to be typical, but plausibility does not ensure typicality for example, events that could plausibly happen to a person, may not necessarily happen to oneself
Factuality	Media that represent a specific, real-world event or person (something that actually happened). However, Hall (2003) noted that participants can adjust their behaviour due to the presence of the camera, thus reducing factual realism
Emotional involvement	The capability of the media to evoke an emotional response is seen as a marker of realism. If you are able to 'feel the characters' emotions or have an affective response to the characters as they would to a real person' (Hall, 2003: 635). Emotional realism can be applied to unrealistic events or situations that are implausible or atypical if the audience is made to feel a sense of connection or involvement with the character
Narrative consistency	Coherent media that does not contradict itself and leaves nothing unexplained
Perceptual persuasiveness	The degree to which a compelling visual illusion, independent of the degree to which the content of the media may relate to the real-world. In other words, the appearance of the representation, rather than the factual realism of the situation

Whilst Hall's (2003) study related to films and television programmes, the methods of evaluating media realism can be applied to simulation-based education scenario design; if a simulation scenario is plausible, typical, factual, ensures emotional involvement, has narrative consistency and is perceptually persuasive, then it will be seen by learners to be realistic. Perceptual persuasiveness can also be related to Stokes-Parish et al.'s (2017) work on moulage; by creating a realistic representation, learners are persuaded that it is realistic. Furthermore, the emotional involvement of simulation can aid learners' engagement with the *fiction contract*, enabling scenarios that may be plausible, but not typical, seem realistic (Hall, 2003; Rudolph et al., 2007). These methods should be considered when designing simulation scenarios.

2.4 Misconceptions around simulation fidelity and realism

In 2015 Tun et al. attempted to bring clarity to the term *simulation fidelity* in healthcare education. The paper entitled 'Redefining Simulation Fidelity for Healthcare Education' (Tun et al., 2015) revealed that there are varied interpretations of the term fidelity, often misused and inconsistently used in the current literature. Tun et al. (2015) highlighted the challenge of deciding what *level* of fidelity is required for effective education. Tun et al. (2015) also claimed that there are a range of definitions for simulation fidelity, with over twenty-two identified in 1992. The definitions of simulation fidelity cover a range of characteristics, including physical, functional, psychological, behavioural, engineering, visual and auditory characteristics (Tun et al., 2015). Often the term fidelity can be confused with the level of technological sophistication, but as previously noted, simulation is a technique, not a technology (Gaba, 2004). Tun et al. (2015) stated that it is not necessary to utilise expensive technology in the pursuit of realism:

> 'A common incorrect assumption we have observed in the literature is that in order to achieve higher levels of fidelity, more advanced (and therefore more expensive) technology is required' (Tun et al., 2015: 165).

Tun et al. (2015) helped to clarify this point by stating that simulators are merely the 'medium' (Tun et al., 2015: 161) that allow Facilitators to conduct simulations. Simulators include part-task trainers, manikins, human simulated patients, screen-based environments, and simulated equipment and healthcare environments (Alinier, 2007; Tun et al., 2015). Whereas simulation is the activity that represents 'real or potentially real-world activities' (Tun et al., 2015: 161). Therefore, simulation fidelity relates to the similarity and realism of a situation and the plausibility, typicality, and factuality of the situation (Hall, 2003).

Further support of the misconception surrounding the term fidelity is provided in a critical commentary by Hamstra et al. (2014), which discussed the confusion surrounding the term *fidelity* in simulation-based education literature. Whilst conducting a systematic review, Hamstra et al. (2014) discovered that fidelity is multifactorial and fidelity requirements vary depending on the learning context. They stated that it is incorrect to assume that greater fidelity will result in greater educational effectiveness; increases in fidelity 'do not necessarily correspond to increases in educational effectiveness' (Hamstra et al., 2014: 388). Fidelity is a confusing term when related to simulators because the same simulator may be viewed as 'high' or 'low fidelity' depending on the features that are emphasised. For example, in the papers explored for their systematic review, Hamstra et al. (2014) discovered that different authors described the same simulator as reflecting high or low fidelity depending on whether they emphasised the 'visual auditory, tactile, or functional features of the simulator' (Hamstra et al., 2014: 387-388). It also depended on the 'learners, learning objectives, and learning context' (Hamstra et al., 2014: 388). Terms such as low, medium, and high fidelity are unclear and subjective; what one person describes as high fidelity may not correspond to another person's perception, therefore fidelity cannot be seen as a bipolar concept as this perspective is 'too simplistic' (Hamstra et al., 2014: 388). Tun et al. (2015) agrees, stating that high-tech manikins are often described as *high fidelity*, and yet they have limitations; they are physically unrealistic and do not provide non-verbal cues, such as body language, skin colour and body temperature. However, if a compelling visual illusion is provided, that is perceptually persuasive and emotionally realistic, then a lack of factual realism should not prevent learner engagement (Hall, 2003).

Confusion with the term *high fidelity* is further noted in a review paper by Norman et al. (2012) that examined the relationship between learner performance on high fidelity simulation (HFS) versus low fidelity simulation (LFS), based on measures of clinical performance (Norman et al., 2012). Evidence from eighteen papers was reviewed and grouped into three areas of learning: Auscultation skills; Basic motor skills; and Complex crisis management. This paper aimed to clarify the debate on HFS versus LFS, however, Norman et al. (2012) confused the situation further by referring throughout the paper to high fidelity *simulation* (HFS), when they are actually referring to high fidelity *simulators*. They were again mistaking simulation technology with simulation as a technique (Gaba, 2004). Hamstra et al. (2014) suggest the term fidelity is 'imprecise on its own and refers, instead, to many separate concepts' (Hamstra et al., 2014: 389).

2.5 Variations in simulation realism

In 2013, Poeschl and Doering developed a self-report questionnaire for measuring simulation realism. A sample of students (n = 151) used the 14-item 'German VR Simulation Realism Scale for VR training applications' to rate the simulation realism of a virtual training application. Whilst this scale was designed to measure realism in virtual reality (VR) applications, it could be adapted and used to measure realism in other simulation-based scenarios and situations. In their paper, Poeschl and Doering (2013) favour the term *realism*. The scale seeks to measure one aspect of immersion, namely, realism or faithful replication of the simulation; the *as if* concept (Dieckmann et al., 2007), claiming that aspects of immersion affect presence and performance (Poeschl and Doering, 2013). Poeschl and Doering (2013) subdivided simulation realism into four-factors: Scene Realism, Audience Behaviour, Audience Appearance and lastly, Sound Realism. They aimed to explore the concept of realism in applications that specifically have virtual humans embedded. It would be interesting to apply this scale to physical simulation, with embedded human simulated patients or manikins, to ascertain whether it can be used to measure simulation realism in scenarios outside of VR training applications.

Tun et al. (2015) described a spectrum of fidelity ranging from objective, positivistic fidelity, which relates to the simulation physicality and its' engineering, up to subjective fidelity pertaining to the psychological and perceptual aspects of simulation that a participant would experience. Hamstra et al. (2014) agreed that fidelity refers to many separate concepts they argue that defining fidelity as *high* or *low* is too simplistic and that fidelity should be viewed on a continuum (Hamstra et al., 2014). They also recommended viewing simulation fidelity from two major dimensions:

1. Structural fidelity (how the simulator appears)
2. Functional fidelity (what the simulator does)

Hamstra et al. (2014) claimed that when learners are oriented to the context and physical platform on which to learn (the structural fidelity), they may be able to 'project fidelity onto the simulation' (Hamstra et al., 2014: 388), thus enhancing functional fidelity. They suggested that by using a constructivist framework, learners can make the context relevant to their own objectives and requirements. They also referred to the distracting effect that high structural fidelity may have on the simulation, suggesting that high structural fidelity can direct attention away from the primary learning objectives (Hamstra et al., 2014). Therefore, it is important to strike the correct balance between structural and functional fidelity, to ensure the learning objectives are achieved (see Figure 2-1). Hamstra et al. (2014) only related this concept to the *simulator* itself, however, it can be extrapolated to incorporate the simulation environment and simulation as a whole. They suggested that there is an optimum area, where the structural and functional fidelity is balanced to facilitate learning.

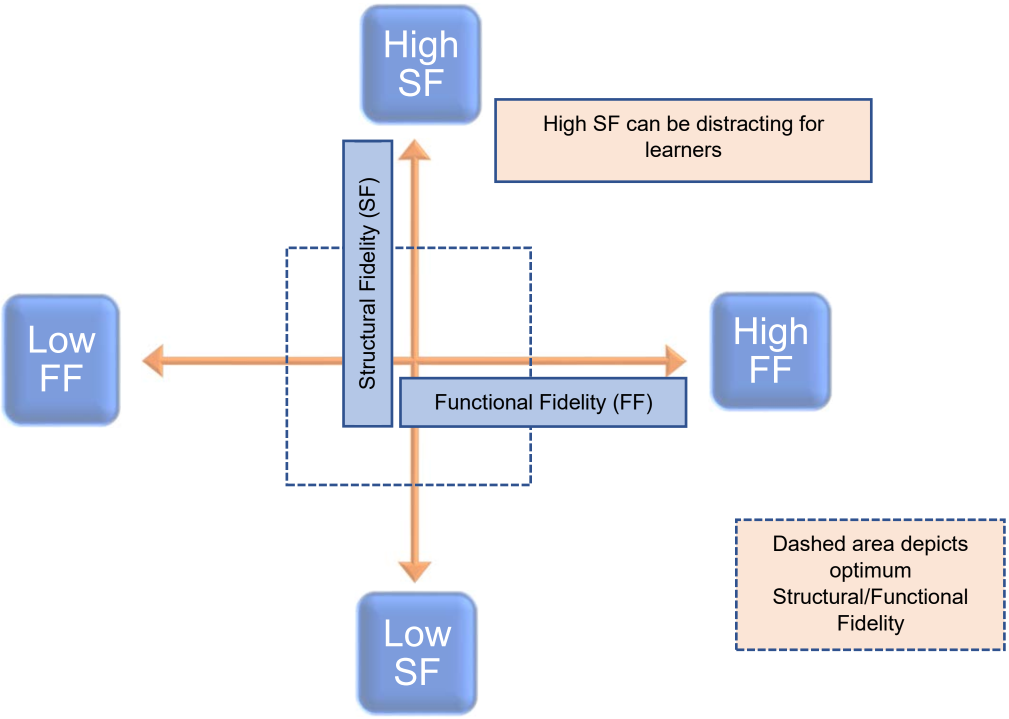


Figure 2-2: Balance between structural and functional fidelity
Adapted from Hamstra et al. (2014)

In addition to education, simulation can be used for other purposes, for example, to test systems and processes. A macro-systems simulation conducted in Rhode Island, USA, by Bender (2011) investigated the integration of specific practices into a new neonatal intensive care unit (NICU) environment prior to commissioning for use by patients and staff. The aim of 'Transportable Enhanced Simulation Technologies for Pre-Implementation Limited Operations Testing in the NICU' (TESTPILOT-NICU) was to assess translation of existing processes to the new NICU, to minimise patient risk exposure, to allow staff from all shifts to explore the new NICU and to subsequently integrate solutions gathered from TESTPILOT-NICU, into the orientation workshop for all staff. Six simultaneous scenarios were designed, and multi-disciplinary teams took part in two progressive simulations, each followed by a debrief. Participants were recruited from all shifts and specialties including nurses, physicians, respiratory therapists, radiology and laboratory technicians, assistant nurse managers, neonatal nurse practitioners, secretaries, and other hospital staff, who were enticed by the opportunity to explore the new NICU. Simulation realism during this study was 'defined by the environmental cues and confederate staff' (Bender, 2011: 81). The response to TESTPILOT was overwhelmingly positive; constructive data was generated during the debriefing process, with participants identifying numerous latent safety threats. The TESTPILOT-NICU findings were used to either modify processes or tailor staff training workshops, both of which aimed to better prepare staff and thus improve patient safety. Bender (2011) suggested that repeated practice via simulation aided the success of the scenarios and mentioned that commitment of staff to the simulation was enhanced by engaging NICU leaders, who acted as frontline participants during TESTPILOT. Bender (2011) advocated scripting of scenarios by a multidisciplinary team and designing scenarios in relation to specific learning objectives. Bender (2011) further suggested that using realistic patient care scenarios with embedded human simulated persons as 'stressed parents' (Bender, 2011: 82) enhanced the realism of the scenarios. The debrief focussed on improving processes, rather than the clinical skills that learners utilised in the scenarios, which reportedly created a less threatening environment for all participants. The benefits of using simulation prior to the transition to the new NICU enabled an understanding of real and specific patient safety risks, without putting neonates at risk. Considering Hamstra et al.'s. (2014) concept, both structural and functional fidelity would have been high during the TESTPILOT-NICU in-situ simulation, however, Bender (2011) reported that learning objectives were met and both processes and patient safety were improved as a result of the simulation. The study by Bender (2011) has implications for future design of simulation-based education scenarios as it suggests that objectives can be met whilst outside of the optimum area for learning, where both structural fidelity and functional fidelity are high.

A paper by Choi et al. (2015) revealed that current nasogastric tube (NGT) training was not realistic. To combat this, Choi et al. (2015) designed a virtual reality (VR)-based training simulation system to facilitate the training of NGT placement. The system simulated NGT insertion and delivered feedback forces with a haptic device. The training system was an interactive, low-cost computer-simulated virtual environment, with anatomical parts (nasogastric passage) modelled on human anatomy. Choi et al. (2015) suggested that this hybrid VR-based training system was an efficient and effective method for learning manual skills, when compared to unrealistic part-task trainers.

Choi et al. (2015) claimed that the benefits of their VR system included:

- The ability to learn complex skills
- Reduction in the need for practicing on patients/cadavers
- Easy availability, which reduced the constraints of space and time in clinical training
- Flexibility, meaning that training can be programmed specific to learner-needs
- Simply achieved using a personal computer (PC) equipped with a generic user interface, for example, keyboard and mouse (non-immersive VR)
- Can be integrated with 3-dimensional (3D) user interface device (immersive VR)
- Safe, controlled, motivating environment for teaching and learning
- Quantitative data and metrics enable evaluation of user performance

When this research was published there were a few VR trainers available for surgical and medical education, but VR training in healthcare education was scarce. Choi et al. (2015) referred to methods to enhance the realism of the system by simulating forces during swallowing to facilitate tube insertion and NGT ‘buckling’ (Choi et al., 2015: 104) at the nostril when the tube was not correctly aligned. The paper went into detail about the design and modelling of the NGT VR system. The benefits of Choi et al.’s (2015) VR-system should be considered when designing any new simulation; the simulation should be fit for purpose, easily availability, flexible, achievable, have the ability to be integrated into other systems, safe, motivating, and evaluative. The realism of the system is key to its success. Nowadays, VR simulation is a more accepted method for healthcare education, with companies offering access to artificially intelligent virtual patients, augmented reality (AR) applications and AR/VR patients and platforms to carry out scenarios[6].

Stokes-Parish et al. (2017) contextualised moulage by providing a background to its use and definition of terms. Moulage examples include bruises, wounds, burns, signs of trauma, sepsis, jaundice, and rashes. Stokes-Parish et al. (2017) used the underpinning theoretical concepts of engagement, authenticity, and realism to identify the place of moulage in simulation. Stokes-Parish et al. (2017) defined engagement as how realistically a simulation activity is portrayed, claiming that engagement is critical to the learners' involvement in the simulation. Stokes-Parish et al. (2017: 48) stated that realism was 'real worldness' and authenticity was complex; 'authenticity of simulation is dependent on multiple, combined factors' (Stokes-Parish et al., 2017: 48). These factors include engagement and realism. Authenticity is defined in this paper as the 'quality of being real or genuine, not fake' (Stokes-Parish et al., 2017: 47) or 'accurately recording or reflecting something' (Stokes-Parish et al., 2017: 47). However, rather than referring to authenticity alone, the authors refer to *authentic context*; the context of how closely the whole experience mimics real life. The level of detail required for authenticity in simulation is under-researched. Visual cues are required to engage learners during simulation. Similar to Hamstra et al.'s (2014) argument that high structural fidelity can direct attention away from the primary learning objectives, Stokes-Parish et al. (2017) agreed that even a small disruption to authenticity can interrupt the realism and cause a learner to dismiss the simulation and disengage. Stokes-Parish et al. (2017) further advocated the necessity of authenticity in even the smallest details, relating this to the presentation of a bruise, which, if not authentically displayed, could be misinterpreted by a learner and 'derail the purposed learning set' (Stokes-Parish et al., 2017: 48).

Stokes-Parish et al. (2017) defined realism as a multidimensional aspect of instructional design. They stated key elements that contributed to realism in media, which are related to

[6] To name a few, Oxford Medical Simulation (OMS): https://oxfordmedicalsimulation.com/, vSim by Laerdal: https://laerdal.com/gb/products/courses-learning/virtual-simulation/, GigXR HoloPatient: https://www.gigxr.com/holopatient/, SimConverse: https://www.simconverse.com/

Hall's (2003) work on media realism (see Table 2-2). In this context, the 'participant' would be the learner, who is participating in the simulation.

Table 2-2: Six key elements that contribute to realism (Stokes-Paresh et al., 2017)

Plausibility	Could it occur in real life?
Typicality	Could it occur readily to the participant?
Factuality	Has the event actually happened?
Involvement	Can the participant relate to the event and feel emotionally involved?
Consistency	Are there any contradictions?
Perceptual persuasiveness	Are the events presented well, could it be real?

Taking care to ensure all of these six key elements are addressed when designing simulation scenarios should ensure that learners are able to engage and learn during the simulation. Clearly there is a connection between realism and emotional involvement. In short, the ability of the participant to relate to the event and feel emotionally involved, which is critical to the success of simulation.

When exploring the spectrum of simulation realism, it is pertinent to draw information from non-healthcare related contexts, since simulation and realism has been embedded into other subject areas for decades. Realism in literature was a movement that focused on the real world and familiar kinds of characters as opposed to the fantastical or supernatural; it began in the 19th century in theatre and aimed to depict real-life in texts and performances. Realism is part of a broader artistic movement that includes naturalism. Émile Zola (1881) wrote extensively about naturalism on the stage, advocating that the 'greatest and most useful lessons will be taught by depicting life as it is' (Zola, 1881: 13). Zola (1881) discussed that, instead of abstract, unrealistic representations of characters, a *natural man* in his proper surroundings was more powerful than supernatural illusions of life:

> '...the anatomy of man, to the painting of life in an exact reproduction more original and powerful than anyone has so far dared to risk' (Zola, 1881: 6).

Zola (1881) claimed that a word or a cry is sufficient to describe an entire character. Time in naturalism occurs in real-time, meaning that no fast-forward, rewind or skipping to another time in the future occurs, and the focus is on unity of time, place, and action. Realism, in the literature context in contrast, can present scenes that are realistic portrayals in separate times, for example, scene one set in the morning and scene two in the afternoon. Naturalism is considered a heightened form of realism, often exploring subject matter previously considered taboo, for example, illness and death. There are distinct crossovers from performing arts literature and simulation-based healthcare education, which influence and complement this body of evidence, and will be considered further in this thesis.

2.6 Impact of realism on learning, engagement, and performance

Bender (2011) discovered that a macro-systems simulation facilitated the improved understanding of the overlay of systems, enabling a smooth integration of processes, and promoting patient safety in the new NICU. Bender's (2011) TESTPILOT simulation resulted in the author advocating of the use of various levels of simulation technology. For example, during the study, high-tech manikins were only integrated into scenarios when required, to demonstrate specific pathophysiology at the bedside; most scenarios incorporated simple, low-tech manikins (Bender, 2011). He reported that 'technology is important only to the extent it enhances realism' (Bender, 2011: 82) and when not used as an unnecessary addition. Bender's (2011) study revealed that technology, when used correctly, had the ability to lure people into the scenario, thus enhancing engagement and performance:

> 'A technology that draws participants into their native roles and helps them forget they are 'playing', at which point they start discovering' (Bender, 2011: 82).

Stokes-Parish et al. (2017) also stated that how realistically a simulation activity is portrayed is critical to the learners' engagement. In order for learners to learn, they must first engage with the simulation activities. They stated that engagement was more than just the physical act of participating in simulation; 'it is also semantic…and phenomenal' (Stokes-Parish et al., 2017: 48). Furthermore, successful engagement in simulation was dependent on 'how realistically it is portrayed' (Stokes-Parish et al., 2017: 47). In other words, the level of realism and its impact on learning is directly related to the learning objectives of the activity. Stokes-Parish et al. (2017) did not investigate whether authenticity was related to transfer of learning, just authenticity and its impact on engagement. Whilst this research is linked to moulage, the impact of engagement discussed can be related to other aspects of simulation that encompass physical, semantic, and phenomenal elements of simulation. Stokes-Parish et al. (2017) also discussed 'dual awareness' (Stokes-Parish et al., 2017: 48), whereby learners can identify what is real and what is not, claiming that this should be encouraged. The concept of dual awareness may enhance learner engagement with simulation-based education and consequently have a positive impact on learning and links directly to the fiction contract discussed previously (Dieckmann et al., 2007; Rudolph et al., 2007).

Research has found that the level of expertise of the learner involved in simulation may also impact on engagement. Norman et al. (2012) and Stokes-Parish et al. (2017) discovered that novice learners did not notice anomalies due to their lack of knowledge. As a result, novices would benefit from simpler scenarios, gradually moving to complex scenarios as their knowledge and skill increase. Expert learners noticed inaccuracies in scenarios and found these distracting (Norman et al., 2012; Stokes-Parish et al., 2017). However, some learners just accepted any inaccuracies and anomalies, due to their prior knowledge and experience, and were able to fill in any gaps using the *as if* concept, which indicates that physical realism may not be required by expert learners in order for them to engage in simulation-based education. Further investigation is required to discover differences in engagement between novice and expert learners.

Norman et al.'s. (2012) review entitled 'The minimal relationship between simulation fidelity and transfer of learning' concluded that the gains of using HFS are modest and not statistically significant when compared to LFS. The researchers also stated that it may be more effective to provide each student with unlimited access to an LFS rather than an hour or two on an HFS, suggesting that repetition of practice is more important than realism. Referring to psychological fidelity or 'the degree of perceived realism, including psychological factors such as emotions, beliefs, and self-awareness of participants in simulation scenarios' (Lopreiato et al., 2016: 38), Norman et al. (2012) claimed that focussing on psychological factors, rather than functional or equipment fidelity, may be a more useful technique to aid or enhance engagement and hence learning:

> '...psychological fidelity may be a more critical determinant of learning and transfer than engineering fidelity' (Norman et al., 2012: 645).

Norman et al. (2012) also revealed that the development of complex skills may not require actual physical practice, rather, remembering the exact sequence of actions to facilitate mental rehearsal of the steps may be enough to develop complex skills. This is known as 'mental simulation' (Sanna, 2000: 168) or 'mental rehearsal' (Norman et al., 2012: 645), which can lead to mastery learning and requires further investigation. In a bid to dispel previous beliefs that higher cost simulators give rise to greater immersion and, therefore, learning, Norman et al. (2012) provided further evidence to suggest that more advanced, high-cost simulators do not bring about 'commensurate increases in learning' (Norman et al., 2012: 645). They concluded that that the level of simulator or 'functional fidelity' (Lopreiato et al., 2016: 19) does not translate to deeper learning.

To interrogate the impact of realism on learning, engagement, and performance further, an experimental study by Keitel et al. (2011) was considered. This study was conducted with 34 trainee anaesthetists to:

1) Compare the stress responses of learners in a simulated emergency situation versus responses to a standard psychological laboratory stressor.
2) Assess the relationship between learners' stress responses and medical performance.
3) Determine whether, and to what extent, an emergency simulation using patient simulator manikins affects learners' psychological and endocrine stress responses.

Both psychological and endocrine stress responses were measured via salivary cortisol and a visual analogue scale (VAS), which were analysed seven times during three conditions: rest (negative control); laboratory stress (positive control); and a simulated emergency situation. The study found that the simulated emergency situation induced substantial psychological and endocrine stress responses in learners when compared to rest, proving that simulation can be stressful and demanding. However, cortisol responses did not differ in both the laboratory stress and simulated emergency situations; both the positive control and simulation condition elicited the same degree of endocrine stress response. Learner's psychological stress responses were higher in the emergency simulation, suggesting that the simulation was perceived to be more psychologically stressful than the laboratory stress situation (Keitel et al., 2011). Interestingly, there was a positive association discovered between increased salivary cortisol response in the laboratory stress test and medical performance in the simulated emergency, suggesting that some of the participants had the ability to cope in a critical emergency situation. This study relates to other findings about novice and expert learner's engagement with simulation (Norman et al., 2012; Stokes-Parish et al., 2017) and will be discussed further in the Section 2.7. However, this research by Keitel et al. (2011) may not translate into other areas of practice; it was conducted with a small sample of trainee anaesthetists so generalisations cannot be drawn as the findings may not be directly transferrable to pre-registration nursing or healthcare student learners.

Keitel et al. (2011) also suggested that the educational effectiveness of an immediate debrief may be hampered by elevated cortisol levels and strong psychological and endocrine responses in some learners, which may obstruct the educational effectiveness of simulation-based education, and subsequent reflection and transfer of knowledge into future practice. Keitel et al. (2011) stated that: 'the massive stress response we observed might hamper educational efforts' (Keitel et al., 2011: 106). This should be brought into consideration when designing simulation scenarios and session plans, to allow for extra time for learners to de-stress following simulated emergency situations.

Hamstra et al.'s (2014) critical commentary discussed the confusion surrounding the term fidelity in simulation-based education literature, recommending careful consideration of the context, kind of task, stages of learning, learner abilities, task difficulty and the effect of various instructional features. They, too, suggested focussing on methods to enhance transfer of learning 'to real-life settings' (Hamstra et al., 2014: 390) through learner orientation, learner engagement and the development of appropriate learning objectives. This is because cognitive engagement is linked to higher learning outcomes. Hamstra et al. (2014) advocated the promotion of suspension of disbelief (Hamstra et al., 2014) or the fiction contract (Dieckmann et al., 2007; Rudolph et al., 2007) during simulation. They recommended learner orientation prior to simulation-based education and the matching of simulation activities to learners' level of training and education, claiming that this will have a positive impact on learner engagement (Hamstra et al., 2014):

> ‘Educational effectiveness results from a complex interaction between the simulator and what the educator and/or the learner does with the simulator, including the provision of appropriate orientation and learning objectives, with the human element most often exerting more influence than the simulator itself’
>
> (Hamstra et al., 2014: 390).

Virtual reality (VR) applications traditionally use high levels of immersion to produce realistic experiences for users by creating high levels of presence. In 2013, Poeschl and Doering proposed a scale to measure simulation realism, particularly in applications that expose users to virtual humans. Whilst this study was conducted on VR applications, there is much cross-over between social VR applications and healthcare simulation involving human simulated patients and/or manikins. Immersive virtual environments (IVEs) use 3D visual imagery, sound, and tactile feedback to enable users to experience a computer-generated world *as if* it were real. Poeschl and Doering (2013) suggested that if users experienced a high level of presence in VR, then it could lead to higher performance. Immersion can positively ‘affect presence and performance’ (Poeschl and Doering, 2013: 34). Findings showed that more realistic VR models led to higher feelings of presence and associated performance. Furthermore, higher simulation fidelity also led to greater transfer of skills into future practice. This study was conducted in a non-healthcare related simulated VR environment; it would be interesting to investigate whether the same phenomena is true for physical simulation environments in a healthcare setting.

Again, drawing on information from outside of healthcare education and research, an experimental study by Hein et al. (2010) was considered, which was concerned with evoking a context using a written scenario and the effect on consumers’ hedonic ratings for food and drink consumption testing. Hedonic scales are used as a method to measure food preferences or acceptability. Hein et al. (2010) claimed that mental contexts (associations) derived from food products gave them meaning. They also stated that if a product is removed from the context where it is normally consumed, that the consumer; ‘may have less involvement with the product’ (Hein et al., 2010: 410). The converse of this could be relevant in the context of simulation-based education; if learners are introduced to a scenario and simulated patient using relevant, contextual information to create an ‘evoked context' (Hein et al., 2010: 410) or mental simulation, then they may develop deeper understanding. This, in turn, could promote greater engagement with the scenario (Rudolph et al., 2007), leading to deeper learning and transfer of learning in simulation to future practice.

There are few carefully designed pre-test/post-test experimental studies that compare simulation-based learning to other educational approaches. One such study by Johnson et al. (2010) was a prospective, randomised experimental study, which investigated whether a CD-ROM or human patient simulator (HPS) high-tech manikin was more effective for teaching military nurses how to care for patients who had been exposed to chemical warfare. Performance was measured using the Management of Chemical Warfare Patients Performance (MCWPP) instrument (Johnson et al., 2010). The researchers ensured that the content presented to participants in both conditions (CD-ROM or HPS) was identical and appropriate by using an expert panel to review the content and revise it until there was one hundred percent agreement that it was comprehensive and accurate. The experimental study found that there was no significant difference discovered between groups' pre-test MCWPP scores, highlighting that the groups were equivalent. However, the groups' MCWPP post-test scores were higher in the HPS group when compared to the CD-ROM and control groups (who received no instruction). This showed that the HPS group performed better than the CD-ROM and control groups.

Johnson et al. (2010) suggested that the reason why the HPS group performed better than the others was that the participants in the HPS group were able to use critical thinking and had the opportunity to apply principles, concepts, theories, and laws. They claimed that the HPS groups had the opportunity to assess, intervene, evaluate, and diagnose in a real-world environment. This is supported by the theory of situated cognition, which emphasises that people's knowledge is constructed within, and linked to, the activity, context, and culture in which it was learned (Brown et al., 1989). The CD-ROM group did not perform as well as the HPS group because the approach was not as realistic as the HPS scenario (Johnson et al., 2010); even though the expert panel agreed that the content was the same. In relation to this, Hein et al. (2010) commented that visual, olfactory, and auditory cues were effective at evoking context. Johnson et al. (2010) used visual and auditory cues in the form of helicopter, artillery fire and bomb blast sound effects during the HPS simulation. Perhaps if the CD-ROM content was more realistic, and the context were created to immerse learners more effectively in the scenario using similar affective cues that the HPS group received, then learners may have been able to develop the higher-level cognition and critical thinking skills necessary to effectively manage complex patient care scenarios. Negative aspects of the HPS intervention were disclosed, including that the HPS is expensive to run and maintain and required a high staff to student ratio to facilitate sessions: ‘the system requires at least 2 individuals: one to teach and one to operate the system’ (Johnson et al., 2010: 15). The researchers also claimed that the HPS was reliable, but ‘on 2 occasions the investigators had to cancel participation until it was repaired’ (Johnson et al., 2010: 15). Facilitation methods and reliability of equipment are important considerations when designing scenarios to be used during simulation-based education.

A paper by Schaumberg (2015) entitled ‘The matter of ‘fidelity’: Keep it simple or complex?’ intended to discuss how much realism must be sought to achieve a particular learning outcome. Schaumberg (2015) found that there was no evidence to suggest how much learners should be stressed in order to achieve learning outcomes, nor was there any evidence to suggest a correlation between simulation realism and learning effectiveness (Schaumberg, 2015). Schaumberg too, asked the question ‘How much realism must be sought to achieve a particular learning outcome?’ (Schaumberg, 2015: 22). Whilst this paper attempts to describe the current state of knowledge in this area, Schaumberg does not answer this question, merely concluding that there is no evidence to correlate realism of simulation to effective learning and that more research in this area is required (Schaumberg, 2015).

Schaumberg (2015) agreed with Keitel et al. (2011), who noted that the stress reaction induced by heightened simulation realism could be detrimental to knowledge transfer. Schaumberg (2015) suggested that highly realistic simulation scenarios should be carefully placed in the curriculum, implying that learners with more experience can endure greater stress levels; ‘it seems necessary to establish a simulation setting suitable for the education level, needs and personality characteristics of the students’ (Schaumberg, 2015: 21). This is contradictory to Poeschl and Doering (2013), who stated that higher simulation fidelity also

led to greater transfer of skills into future practice. However, the study by Poeschl and Doering (2013) was conducted in VR environments and findings may not be directly transferrable to physical immersive simulation. More research to investigate this, and to test the appropriate *level* of stress in novice and expert learners is required.
There is insufficient evidence to suggest how much simulated reality is required to achieve successful knowledge construction and subsequent reflection and transfer of learning into future practice. Engagement with simulation can be improved by using appropriate technology, detailed learner orientation and induction, matching simulation scenarios to the learners' level of education and training, encouraging mental simulation and by promoting increased presence or immersion for learners during simulation.

2.7 New concepts in simulation design

The term 'absolute fidelity' was proposed by Tun et al. (2015: 161) as the top end of the fidelity spectrum where the simulation is realistic to the point that it cannot be differentiated from reality. They claimed that 'absolute fidelity' (Tun et al., 2015: 161) was not necessarily achieved through replication of reality atom for atom, but through realistic cues (verbal and emotional) and other stimuli. This can be seen as 'benevolent deception' (Tun et al., 2015: 163), which is deception used to trick the learners for their benefit, so that they can more effectively acquiesce or *buy-in* to a realistically presented scenario and thus, enhance the learning experience. This further emphasises the need for a *fiction contract* (Dieckmann et al., 2007; Rudolph et al., 2007; Tun et al., 2015) with learners, so they can accept the limitations of the simulation and agree to be 'willingly deceived' (Tun et al., 2015: 164). The concept of 'benevolent deception' (Tun et al., 2015: 163) may help to mitigate learners from highlighting the limitations of the simulation during the debrief and blaming their own poor performance on lack of immersion or 'functional fidelity' (Lioce et al., 2020: 19). Hamstra et al. (2014) claimed that to obtain 'buy-in' (Hamstra et al., 2014: 388) and 'suspension of disbelief' (Hamstra et al., 2014: 387) from learners, one must provide an introduction and briefing, to expose limitations of the setting, environment, equipment and simulated patient or manikin. 'Benevolent deception' (Tun et al., 2015: 163) will be considered further in Chapter 3, in relation to ethical considerations for simulation-based education.

Tun et al. (2015) stated that fidelity is different from re-creating every element of reality; simulation needs to allow 'benevolent deception' (Tun et al., 2015: 163) to be introduced. Fidelity is the degree of accuracy to which a simulation (physical, mental or both) represents a given frame of reality in terms of cues, stimuli, and interactions. Tun et al. (2015) suggested a movement away from a linear, unilateral labelling of simulation fidelity and move towards a three-dimensional (3D) model of simulation fidelity for healthcare education (see Figure 2-2), which would aid simulation research, design, and delivery. The three dimensions are 'the patient, the healthcare facility or environment and the clinical scenario' (Tun et al., 2015: 167). Using this 3D framework, simulation facilitators are better able to make comparisons, determine the educational effectiveness or 'educational value' (Tun et al., 2015: 160) and therefore design more effective simulation scenarios.

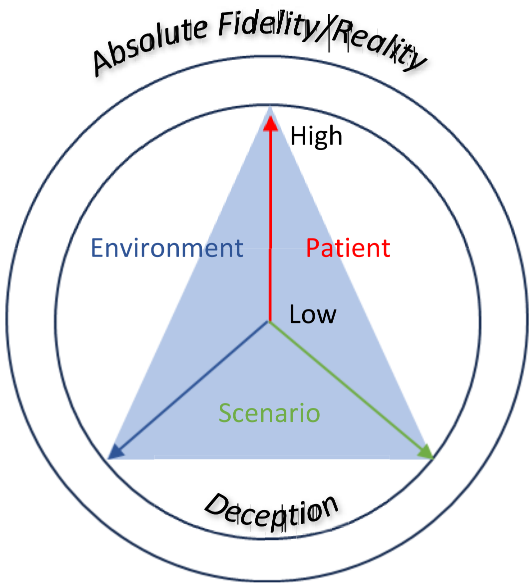


Figure 2-3: 3D model of simulation fidelity for healthcare education
Adapted from Tun et al., 2015: 167

Hamstra et al. (2014) suggested several concepts and recommendations that they felt would change the way in which simulation realism is viewed, with the intention of improving learners' experience. Using constructive alignment and instructional design (Chiniara et al., 2013) to guide the scenario design, would enable the learning objectives to lead the design rather than the technology, allowing facilitators to ask, 'what are we going to teach' rather than 'how can we use the existing platform to teach this skill' (Hamstra et al., 2014: 389). Furthermore, Hamstra et al. (2014) recommended that the term 'fidelity' be abandoned altogether:

> ‘Recommendation #1: Abandon the term fidelity. We recommend that the multidimensional and imprecise term fidelity be abandoned. More directly useful terms should be employed that reflect principles of effective training and transfer, such as physical resemblance and functional task alignment’
>
> (Hamstra et al., 2014: 390).

This shift of emphasis from physical resemblance to functional task alignment would help to ensure that the physical properties of the simulator were secondary to the functional task alignment and instructional design. Hamstra et al. (2014) also stated that it would be beneficial to focus the use of simulation for teaching high-acuity (severity), low-opportunity (frequency) events (Chiniara et al., 2013), also known as HALO events, which would reduce the need for using immersive simulation scenarios for teaching and learning routine clinical scenarios. However, HALO scenarios, for example, simulating a surgical ‘never event’[7] (Burnett, 2018: 2) would only be appropriate for experienced learners, and would not replace the requirement for other modalities of simulation for teaching and learning essential and clinical skills. Hamstra et al. (2014) believed that there is a need to discover for which tasks physical resemblance is important and how it is possible to enhance engagement in a simulation scenario. Stokes-Parish et al. (2017) concurs; they do not use the term ‘fidelity’ and explain that this is due to confusion and lack of clarity regarding its definition, agreeing that the term should be abandoned and instead focus should be shifted to principles for effective learning.

Further new concepts in simulation design are discussed by Choi et al. (2015), who suggested methods to enhance the realism of their VR system. These suggestions included:

- using medical scan data from real human anatomy
- comparing the computer-generated forces with real NGT insertion in-situ
- simulating the torque generated during the rotation of the tube during NGT obstruction

[7] Never Events: patient safety incidents that are considered preventable had national guidance or safety recommendations been implemented by healthcare providers (Burnett, 2018).

- simulating unsuccessful and difficult NGT insertion as well as normal and successful insertions; simulating patient's normal responses, for example, gagging and coughing with sound effects
- using an immersive workbench to align the user's hand and the haptic device or 3D goggles

These suggestions for future work in this area are helpful to guide the direction of further realistic simulation. Choi et al. (2015) concluded that the NGT VR system is an attempt to modernise clinical education using VR technology for experiential clinical training in a low-cost, risk-free, flexible virtual environment. However, they suggested that more work is required to enhance some features of their system along with a full usability study using psychometric questionnaires and structured interviews to evaluate and discover accuracy, latency, ease of use, usefulness, user satisfaction and level of virtual realism, with a view to improving the system. Comparison of training effectiveness should then also be evaluated in comparison to traditional NGT insertion.

Stokes-Parish et al. (2017) suggested further research is required to discover whether complete authenticity is required for effective simulation-based healthcare education. They also stated that it is important to discover whether moulage is essential to some disciplines but not others, for example, dermatology, and explore the relationship between moulage, authenticity and engagement. Stokes-Parish et al. (2017) recommended the development of a framework for authenticity in visual cues to allow for benchmarking and comparison between modalities to create authentic portrayal and for comparison studies to explore a non-authentic moulage presentation versus authentic moulage. Whether learners are influenced by the accuracy of moulage portrayal and if this subsequently impacts on their engagement with simulation is another area for further investigation. Further studies to investigate whether learners value authentic simulation more than unauthentic portrayals and the impact that authentic portrayal of moulage has upon the engagement of novice learners compared with an expert learner are also required.

According to cognitive load theory (Sweller, 1988), learners must have considerable pre-requisite skills to benefit from simulation; additional theoretical load may detract from learning because learners without the pre-requisite skills are unable to process more incoming information. Novices would benefit from simpler models and scenarios with a gradual move to more complex models and scenarios as their skills increase, which can be referred to as ‘progressive fidelity’ (Norman et al., 2012: 642).

There are various means of assessing realism, not just plausibility, and should be considered when designing simulation scenarios. Plausibility and typicality as outlined by Hall (2003) may be shaped and interpreted differently by the learners’ experience. This corresponds to learners’ ability to cope in situations (Keitel et al., 2011) and learners’ real-world experience, which enable them to ‘project fidelity’ (Hamstra et al., 2014: 388) onto a situation and ‘suspend disbelief’ (Hamstra et al., 2014: 391). Learner’s ability to cope with difficult situations should be explored further in relation to the concept of self-efficacy.

Hall (2003) made suggestions for future research into the area of emotional involvement, narrative consistency, and perceptual persuasiveness, suggesting the need for further studies to investigate these concepts and thus highlighting the need for this PhD study. Hall (2003) conducted experimental research to evaluate realism of media texts, the impact of audiences’ enjoyment of media and how much audience members learn from, or are influenced by, a media text. This highlights the need for an investigation linking realism to learning, with the addition of media to enhance the realism of scenarios, specifically in the area of healthcare education. Hall (2003) also stated that there are differences in how viewers evaluate media realism, which should be explored and could be transferred to realism in simulation-based healthcare education. Whilst Hall’s (2003) study was conducted in a media text context, the concepts and suggestions can be related to realism and scenario design in healthcare education.

Poeschl and Doering (2013) developed a fourteen-item, self-report questionnaire to measure realism in VR simulations. The German VR Simulation Realism Scale comprises items relating to one of four subscales or factors: scene realism, audience behaviour, audience appearance and sound realism. Poeschl and Doering (2013) suggested that further research should test the scale in different settings. One vision could be to adapt the German VR Simulation Realism Scale and use it to test the self-reported realism of simulation-based healthcare education scenarios. There are some elements of the scale that are only relevant for a simulation environment depicted in a virtual space, however, by substituting the terms *virtual space* and *CAVE*[8] for *simulation room* and the term *virtual humans* for *simulated people*, the scale could be tested to evaluate its effectiveness in a different context and setting.

In their experimental study to investigate the effect of using written scenarios on consumers' hedonic ratings for food and drink consumption, Hein et al. (2010) discovered that product testing by users under natural conditions is expensive and time-consuming when compared with laboratory settings, which is also true for in-situ healthcare simulation. Whilst physical methods have been used in the past to evoke different contexts during product testing, for example, by changing the décor, photos, curtains and lights, these physical methods have had limited success. Emotions, people, weather, and time are more commonly related to, and associated with, food consumption. Hein et al. (2010) found that 'visual, olfactory, and auditory cues' (Hein et al., 2010: 411) (sight, smell, and sound) have been more successful at evoking contexts. Hein and colleagues suggested that consumer testing should be more realistic and propose that written scenarios can aid this:

> '…written scenarios are statements or brief texts that describe a particular situation meant to evoke a sense of presence in a real situation' (Hein et al., 2010: 411).

The study by Hein et al. (2010) found that one of the benefits of using written scenarios was that major modifications to the physical environment were not required. Hein et al. (2010) also stated that if the context is not accurately portrayed, realism is diminished, and consumers are unable to be properly engaged with the simulation. This may also relate to learners in a simulation-based healthcare situation, perhaps learners will be more engaged with a simulation if realism is enhanced, and the context portrayed accurately. Using the *as-if* concept (Vaihinger, 1927; Dieckmann et al., 2007) is one way to accurately portray contexts. Using written scenarios to suggest a specific context or 'set the scene' (Roberts

[8] CAVE stands for Cave Automatic Virtual Environment, these are virtual reality (VR) environments that consist of a cube-shaped room in which the walls, floors and ceilings are projection screens. They can be used to simulate difference virtual environments and also can contain touch-sensitive 'hotspots' for interactivity.

and Greene, 2011: 696) allowed consumers to have a sense of presence in the scenario (Poeschl and Doering, 2013), it also increased the consumers' involvement, confidence, concentration, and attention (Hein et al., 2010). Furthermore, the written scenarios evoked an emotional mind-set and improved the affective (emotional) response in consumers, rather than a more cognitive (analytical) or psychomotor (physical) response. Further research is required to compare the use of physical methods to evoke a context with use of written scenarios to evoke a context in a simulated healthcare setting.

Johnson et al. (2010) recommended using a pre-test/post-test experimental design to analyse different content delivered during simulation and this should be considered for future studies.

Dieckmann et al. (2007) also made recommendations and suggest options for facilitators to improve simulation and these are listed below:

1) Learners accept the *as-if* concept and are able to suspend disbelief
2) Learners acknowledge and accept the artificial nature of simulation but see beyond this to enable the achievement of overall session learning objectives

Dieckmann et al. (2007) advocated helping learners to accept the *as-if* concept, in a bid to increase the overall believability of the simulation. Furthermore, learners should be encouraged to reflect on the simulation in relation to real clinical cases, therefore increasing semantical understanding (conceptual mode) and enabling them to make phenomenal sense (emotional and experiential mode) of the simulation. Facilitators should also acknowledge and reveal the limitations of simulation and 'functional fidelity' (Lioce at al., 2020: 19) of simulators, which would enable learners to focus on the learning goals, rather than physical realism. Using rituals to start and end scenarios, for example, announcements to begin and end the scenario, strict dress codes during simulation, a suitable 'case briefing' (Dieckmann et al., 2007: 190) to introduce the scenario and always following established and communicated 'rules of the game' (Dieckmann et al., 2007: 190) benefited the learners, enabling them to engage and learn more effectively. Dieckmann et al. (2007) also stated that 'there should be enough realism of the right type for the purpose of the simulation' (Dieckmann et al., 2007: 191), with the purpose of the simulation being the specific learning objectives as dictated in the scenario design. However, Dieckmann et al. (2007) did not claim to know how much realism is sufficient for the learners to learn, nor did they know how to design scenarios with the right amount of realism. This PhD study aims to contribute to the evidence-base to support and advance Dieckmann et al.'s (2007) work by exploring different simulation modalities to ascertain the level of realism and the subsequent effect that realism has on learner's engagement and emotional response. This may provide evidence that will enable facilitators to consider the appropriate simulation modality and level of realism, which will enable learners to achieve the scenario learning objectives.

Rudolph et al. (2007) suggested the following guidelines for successful simulation, but noted that it was important to blend all three modes of thinking in simulation scenario design:

- High physical realism is important for developing kinaesthetic (physical, tactile) skills
- High conceptual realism is important for developing clinical reasoning and diagnostic problem-solving skills
- High emotional and experiential realism is important for helping learners to manage complex processes involving emotion and cognition

Concluding that further research is needed to investigate how to provide psychological support for learners in emotional and experiential simulation, for example, during high-stakes simulation for assessment purposes or during high-acuity, low-opportunity (HALO) events (Chiniara et al., 2013), simulated clinical emergencies or 'never events' (Burnett, 2018). However, this clearly highlights the need to investigate the learners' levels of emotion experienced during simulation, prior to offering psychological support that may not be required.

Schaumberg (2015) stated in their paper that simulation realism depends on the skills, abilities or competencies that are to be undertaken, adding that the degree of realism corresponded to the scenario author's learning goals or objectives. The type of simulation, or simulation approach, is dependent on the learner; using realistic part-task trainers or 'human-like phantoms' (Schaumberg, 2015: 22) for hard technical skills is appropriate for experienced learners, but new technical skills must first be taught in a different setting, prior to immersive simulation. This highlights that realistic, immersive simulations should be used to rehearse and practise non-technical skills, rather than for initially learning technical or clinical skills. Furthermore, the simulation should be as anatomically or physiologically realistic as possible when used for learning technical skills. On the other hand, simulation realism can 'poses less stringent requirements' (Schaumberg, 2015: 24) when used for non-technical skills.

2.8 Chapter summary

This narrative literature review has uncovered and defined different terminology used to describe realism in simulation-based healthcare education. Various misconceptions associated with simulation fidelity and realism have been presented and clarified. Variations in simulation fidelity has been explored, along with the impact of differing variations of realism on learning, engagement, and performance. Evidence from media, performing arts, food studies, virtual reality, healthcare, and medical contexts have been explored to add weight and depth to the evidence-base (literature is tabulated in Appendix B). New concepts in simulation design have also been discussed that situate the proposed research study within a broader educational framework, that build on previous research studies and further highlight the need for this PhD study.

CHAPTER 3 - METHODOLOGY

3.0 Chapter overview

In this chapter, the overarching research question, study aim, and objectives will be defined. The theoretical framework that supports this thesis will then be presented, followed by a discussion relating to the broad philosophical underpinnings and methodological approach taken in this research. Mixed methods research will also be discussed, along with the ethical considerations related to simulation-based education practice and research.

3.1 Research question, study aim and objectives

At this point, it is important to state the research question, study aim and objectives within the context of research methodology. The chosen methods are mixed (qualitative and quantitative), however, this chapter will outline the overarching methodological considerations, before discussing the research process in detail in Chapter Four.

3.1.1 Defining the research question

The overarching research question (RQ) was structured using the SPIDER Tool (Cooke et al., 2012). The SPIDER Tool was selected rather than any other framework as it is suitable for identifying research questions that use mixed methods (Methley et al., 2014) and enables key concepts to be outlined in a structured manner:

Sample (S)	Undergraduate student learners
Phenomenon of Interest (PI)	Simulation realism
Design (D)	Questionnaires and observation
Evaluation (E)	Effect on engagement and emotional response
Research Type (R)	Mixed methods

Based on this structured process, the overarching RQ is defined as: Does realism effect undergraduate student learner's engagement and emotional response during simulation-based education?

3.1.2 Study aim

This thesis aims to explore different simulation-based education modalities from the spectrum of simulation (Greene, 2021), with the intention of discovering whether different levels of realism have an effect on the quality of simulation-based healthcare education and the learning experience, which would lead to enhanced knowledge, and positive emotions and behaviours.

3.1.3 Study objectives

To explore the overarching research question, the following objectives were constructed:

a) To identify any differences in realism between three simulation modalities
b) To explore whether realism effects learner's knowledge
c) To gain a baseline measure of learner's self-efficacy to explore the effect of self-efficacy on undergraduate student's ability to cope with the challenge of different simulation-based education scenarios
d) To gather data on the intensity of learner's emotions before and after engaging with different simulation-based education scenarios
e) To observe learner's behaviour during simulation-based education

3.2 Theoretical framework

The theoretical framework that guides and supports this research is Bandura's Social Learning Theory (Bandura, 1977a). Bandura's body of work stems from his research into observational learning and modelling. This resulted in his theory of social learning, which he expanded in 1986 to include social-cognitive theory. Bandura extended this theory further in 1997, where he published on self-efficacy (Bandura, 1997; Krapp, 2005). Bandura posited that during social learning, there are three factors that are involved in any interaction that are interdependent 'interlocking determinants of each other' (Bandura, 1977a: 10). These determinants of behaviour are Personal, Behavioural and Environmental factors. Personal factors comprise learner's cognitive abilities, their self-efficacy beliefs, attitudes, and emotions. Behavioural factors include learner's performance, their skills, and physical abilities, while Environmental factors are not fixed, they can be initiated, activated, or constructed by learner's behaviour, attitudes, and expectations. The interlocking nature of these factors is summarised in the quote below and illustrated in Figure 3-1:

'Thus behaviour partly determines which of the many potential environmental influences will come into play and what forms they will take; environmental influences…determine which behavioural repertoires are developed and activated'

(Bandura, 1977a: 195).

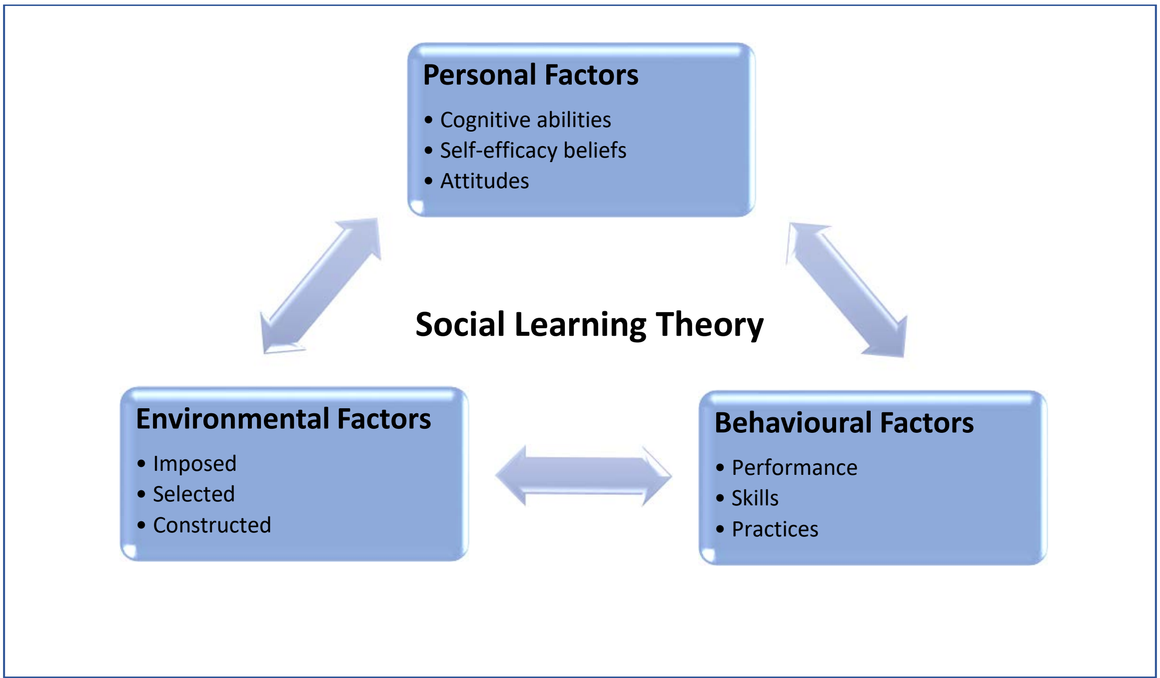


Figure 3-1: Personal, Behavioural and Environmental factors - Interlocking determinants of interaction (Based on Bandura, 1977a)

Bandura believed that learning was not a passive process; his Social Learning Theory is based on four mental processes, that people actively progressed through to learn. These four processes are Attention, Retention, Motor Reproduction and Motivation (Bandura, 1977a). During Attention, learners observe characteristics and the situation, in the Retention phase, learners mentally process the observed behaviours and store them in their memory. Motor reproduction is where learners turn the stored memories into a physical action and rehearse behaviours, finally Motivation is the learner's drive or desire to imitate behaviours (Bandura, 1977a; Krapp, 2005). Bandura also published on 'human agency' (Bandura, 1997: 3, 2006: 164), which explains that people can shape their life circumstances and the courses their lives take, that they can control the nature and quality of events that occur and, rather than passively learning, people are 'active directors of their own lives' (Krapp, 2005: 51).

Variations in people's behaviours are a result of interactions between each other and the situation they find themselves in. Therefore, it was felt that it was important during this study to measure variations in learner's behaviour during different situations to ascertain whether there were any differences in their behaviour across different scenarios. Social Learning Theory recognises vicarious learning and symbolic processes that are self-regulatory, which can influence and change behaviours and hence stimulate learning (Bandura, 1977a). In other words, learning can occur as a result of vicarious learning, observing, and modelling other people's behaviours, and because of direct experience. The self-regulatory nature of social learning means that learners decide which actions to perform based on environmental cues, their understanding/cognition and through considering the consequences of their actions.

According to Bandura (1977a) modelling produces learning: 'most human behaviour is learned observationally though modelling' (Bandura, 1977a: 22). Learners can model behaviours by observing each other peer-to-peer or by observing teachers, facilitators or through symbolic modelling via television, digital media, or visual cues. Using modelling, learners learn by example, and carry their observed behaviours through to the next learning experience. Learners also recognise patterns of behaviours that they determine whether to repeat or disregard (Bandura, 1977a). During the Retention process, learners use visual imagery, symbols and 'verbal codes' (Bandura, 1977a: 26) to transform the observed behaviours into mental rehearsals. Following this, learners convert these symbols or visual imagery into actions or 'behavioural enactment' (Bandura, 1977a: 27), where skills are practised, self-corrected and refined.

The processes depicted in Social Learning Theory align with simulation-based education and are particularly relevant to this study, which investigated the effect of simulation realism on learner's engagement and emotional response during simulation-based education. Furthermore, learner's self-efficacy is of particular interest in the context of simulation-based education. Bandura (1997) stated that self-efficacy is concerned with people's beliefs about their capabilities to organise and execute designated courses of action:

> ‘Perceived self-efficacy is concerned not with the number of skills you have, but with what you believe you can do with what you have under a variety of circumstances’ (Bandura, 1997b: 37).

Specific objectives (Section 3.1.3) aimed to investigate learner’s baseline self-efficacy, to explore whether it had an impact on behaviour (see Study objectives c and e); to discover if people with similar skills in different circumstances perform differently depending on their perceived self-efficacy (Bandura, 1977b). Further, to investigate the nature of fear as a barrier to learning, as is so often seen in simulation-based education that learners become anxious and uncomfortable when performing in front of their peers (Nehring and Lashley, 2004), which again is linked to Social Learning Theory; Bandura (1977a) noted that anxiety activates fear and defensive behaviours. This heightened arousal can impact the learning experience negatively. The emotional response can be heightened towards environments, words, events and situations and this emotional response can be produced not only from physical exposure but also ‘vicarious arousal’ (Bandura, 1977a: 65). This is known as *fear learning*, whereby learners can create fear responses from their own thoughts or via direct experience. This again, is an interesting area for consideration within the context of simulation-based education, where performance anxiety and fear can impact on learning. Social Learning Theory (Bandura, 1977a) supports this current research, providing a theoretical framework to guide the analysis of qualitative data, to provide a rationale for ideas, and to support explanations and interpretations of the data.

3.3 Epistemology and Ontology related to this thesis

The term science is derived from the Latin word ‘scientia’, meaning knowledge (Parahoo, 1997: 35). The aim of science is to produce a body of knowledge in order to make sense of the world by enhancing our knowledge and understanding of phenomena, which is the intention of this thesis. Knowledge is constructed through the process of induction and deduction. The inductive approach uses ‘observations’ to build an abstraction or to describe a ‘picture of the phenomenon that is being studied’ (Lodico et al., 2010: 10). Using the inductive approach there is no theory at the beginning point to guide the research, however theories may evolve as a result of the research. Conversely, the deductive approach is the process of formulating a theory or hypothesis, then collecting data to support or reject this hypothesis (Parahoo, 1997: 36). The approach taken for this study was both inductive and deductive, with the intention of producing a body of knowledge to answer the stated research question.

Epistemology informs a researcher's theoretical perspective; it is the theory of knowledge and is a way of understanding and explaining 'how we know what we know' (Crotty, 1998: 8). Epistemology is embedded into both the theoretical perspective and methodology. My personal background in biochemical sciences was framed by objectivism. Objectivism is the notion that an objective truth exists and can be discovered by the accumulation of more complete information. Objectivist epistemology suggests that meaning and reality exist separate from 'conscious' thought (Crotty, 1998: 8). Objectivism is an ontology and an epistemology. Objectivist epistemology presupposes an objectivist ontology; in order to objectively know the world, there must be a real objective, definite world. The relationship between objectivist ontology and epistemology is best supported by the philosophy of science known as critical realism (Crotty, 1998). Critical realism maintains that things are too grand and complex to be known through the senses; they can and must be known by conceptual thinking objectified in scientific theories (Ratner, 1997), with the intention of discovering an 'objective truth' (Crotty, 1998: 8). Although this approach framed much of my own undergraduate education and scientific practices[9], it does not align to the research undertaken in this thesis, where human interactions, behaviours and emotions were inherent for the discovery of new knowledge. Therefore, this approach was rejected in favour of a constructionist stance. The rationale for this approach will be detailed below.

3.3.1 Constructionism

Constructionism is a learning theory developed by Papert in the 1980s, who 'advocated that learning is most effective when the learner designs or constructs a tangible or meaningful

[9] My undergraduate degree is a BSc (Hons) Biochemical Sciences with Industrial Experience, during my degree placement, I worked in the Biochemistry and Haematology laboratory at Manchester Royal Infirmary. After graduation I secured a job as a quality control laboratory technician, working for a large pharmaceutical company in Liverpool. My scientific background framed my early positivist worldview, however, since my postgraduate studies (MRes in Health and Social Care and PGCert Higher Education Practice and Research) and subsequent knowledge and experience, this has changed to become more in favour of a constructionist epistemological perspective.

product as part of an educational activity' (Rob and Rob, 2018: 274; Papert, 1980). Constructionism believes that social phenomena and their meanings are achieved and constructed by social 'actors' (Bryman, 2012: 33); 'Meaning is not discovered, but constructed' (Crotty, 1998: 42). Constructionism posits that knowledge can be gained from social interaction, which is constantly changing. Constructionism, according to Crotty (1998), is the view that all knowledge is constructed by interactions between humans and human engagement in the human world within a social context. This means that meaning can only emerge when conscious minds engage with objects to make sense of them; 'We do not create meaning. We construct meaning' (Crotty, 1998: 43-44), and this meaning is constructed from the world and objects in the world. Objects can be changed and shaped by consciousness and interactions with objects. It is important to recognise that meaning is not to be conjured up and imposed on objects (Crotty, 1998), meaning is developed, related-to and emerges from interaction with objects.

Constructionism as a theory is appropriate in this context, as opposed to constructivism. This is because constructivism focusses on individuals, whereas constructionism is related to a 'collective generation' (Crotty, 1998: 58) of meaning. Since this thesis is concerned with groups of learners, rather than individuals, and is interested in collective, rather than unique experiences, constructionism as a theory has been used to explain the interactions that occurred during simulation-based education. As Rob and Rob (2018) explain, constructionism theory occurs during educational activities, where the creation process and the end products are 'shared with others' (Rob and Rob, 2018: 274).

Imagination and creativity are required to work within a constructionist epistemology, which fits with the creative nature of simulation-based education. The difference between creativity and innovation is important to consider, prior to thinking about why we seek to teach in a creative or innovative way. Creativity is the use of imagination or original ideas to create something. A creative person has the ability to invent and develop original ideas, especially in art. Synonyms include inventive, imaginative, inspiration and originality (Collinsdictionary.com, 2022*).* On the other hand, to innovate means to make changes in something established, especially by introducing new methods, ideas, or products. An innovation is a new thing or new method of doing something. Synonyms include transformation, change and novelty (Collinsdictionary.com, 2022). Therefore, the difference between creativity and innovation is that to be creative one must develop or invent something original, whereas to be innovative one must make changes to something that already exists. In short, creativity makes something new, innovation changes something for the better. Simulation-based education is both a creative and innovative method of teaching and learning. This research explored different modalities of simulation-based education using appropriate research theories and methodologies that align with these creative and innovative educational methods.

3.3.2 Social Constructionism

Social constructionism theory goes one step further to explain how meaning is socially constructed. Social constructionism evolved in the mid-20th century (Berger and Luckmann, 1966). Social constructionism suggests that all meaning is socially created and arises out of human relationships (Vinney, 2021). As specified in the Oxford Reference on social constructionism, 'society is actively and creatively produced by human beings' (Oxford Reference, 2022). Social constructionism takes into account culture, emotions, and reality (Crotty, 1998), where reality and the meaning that one generates from the world is socially constructed and in which the 'actors' are 'constantly involved in interpreting' (Crotty, 1998: 56).

This research focussed on discovery of meaning through curiosity. Whilst a scientific background could lean one toward the discovery of an objective truth, my further education, knowledge, curiosity, and life experiences suggest that knowledge can be gained from other methodologies, including discovery, innovation, and creation of new knowledge. Through my own accounts and interpretations of the research, data objects were socially constructed, interpreted, and analysed.

3.4 Theoretical perspectives related to this thesis

3.4.1 Postpositivist perspective

As a philosophy, positivism adheres to the view that only 'factual' knowledge, gained through observation and measurement, is trustworthy. In positivist studies, the role of the researcher is limited to data collection and interpretation of the research findings. In the current study, data were obtained through objectivity, observation, quantification, and extrapolation, therefore validating a postpositivist, rather than a positivist, perspective (Crotty, 1998).

A postpositivist perspective informs the research; based on the belief that a reality exists, but that reality can be imperfect, because of bias (Crotty, 1998). This perspective acknowledges the presence of bias and suggests that the researcher cannot be an independent observer of the social world in which the research is taking place. Postpositivism accepts that researchers *do* influence their own research; their observations, experience and influence impacts on the conclusions drawn. Acknowledging the relationship between the researcher, the research participants and institution enables an acceptance of potential bias but also the many benefits associated with embedded research. McGinity and Salokangas (2014) define embedded researchers as people who work inside host organisations as members of staff, while also maintaining an affiliation with an academic institution. They also state that embedded research generates a 'collaborative research agenda' (McGinity and Salokangas, 2014: 3) but they, and others (Reen et al., 2021), acknowledge associated benefits and challenges of embedded researchers and the potential for bias that may result (Table 3-1).

Table 3-1: Benefits and challenges of acting as an embedded researcher (Adapted from McGinity and Salokangas, 2014; and Reen et al., 2021)

Benefits	Challenges	Personal reflections
Collaborative/co-production research agenda	Gaining informed consent without coercion and maintenance of confidentiality	I gained informed consent from research participants, specified that participation was optional and anonymised all results
Greater access to host organisation for collecting data	Moral responsibility aligned to host organisation or participants	It remains my responsibility to feedback findings to my host organisation
Ability to observe, learn and share knowledge, ideas, and best practice	Positionality – researcher or employee	My position was as a researcher/part-time student for PhD study and an employee for all other activities
Strengthening links between education, research, and practice	Whose stories are being told and whose voices are being heard	Student learner's stories, voices, actions, and experiences were analysed
Understanding of the priorities of host organisation	PhD funded by the organisation researcher is embedded in	Priorities of host organisation were to use the data to better understand the effect of realism during simulation-based education, to change and enhance future educational practices
Investigating 'real-world', relevant projects	Power dynamics/ relationships leading to blurring of lines between Academic/Researcher role	Positioned myself as an embedded researcher to student learners, who did not know me and had never previously been taught by me

During this study I acted as an embedded researcher; conducting my research within the organisation where I was employed and who funded this PhD study. My intention was to share knowledge, ideas and best practice with my institution and other higher education institutions in the UK and Internationally, to improve teaching and learning experiences for student learners. However, I was conscious of, and acknowledge, my own personal agendas and biases throughout this research journey, with a view 'to aspire to detachment but at the same time to accept its ultimate impossibility' (Fox, 2008: 6). As an academic member of staff acting as a researcher, there was potential for power imbalance, which may have led to blurring of lines between my academic and researcher roles. This may have led to student learners feeling disempowered due to unequal power dynamics. Furthermore, the student learners could have seen me as ‘dominant’ (Miles et al., 2021: 525), which can prevent participants from sharing critical information during the research process. Biased data collection occurs when power imbalances are present, which can also affect participant’s responses and their willingness to share information. In order to minimise this power imbalance (Miles et al., 2021) and recognising my positionality within the research process, I ensured that the relationship was one of ‘reciprocal collaboration’ (Herr and Anderson, 2005, 2014); making sure by spending time with the students we were an insider-outsider team and that we were co-partners in the creation of knowledge (Holmes, 2020). I acknowledged and recognised that I was part of the social world that I was researching (Holmes, 2020) and, at first, I may have been seen by the student learners as an outsider, as I was unknown to them. However, as time passed, more contact and discussion took place over the course of the three weeks’ sessions I attended and I was increasingly viewed as an insider ‘due to familiarity’ (Holmes, 2020: 8). Recognising the potential for power imbalance ensured measures were in place to aid robust data collection, while reflexivity and transparency enabled me to recognise and acknowledge my own potential biases. During the research I worked as an insider-outsider alongside students and colleagues to produce research that would provide organisational, educational transformation for the benefit of the learners, but also in order to produce data to be used for this thesis. Informed consent without coercion was gained from the participants and at all times I ensured the relationship between researcher and participants was respectful, balanced, and mutually beneficial (Liu and Burnett, 2022). Ethical considerations related to moral responsibility, positionality and my own research approach will be discussed later in this chapter.

3.4.2 Interpretivism

The products of social research contribute to theory and knowledge; ‘Social research is informed and influenced by theory’ (Bryman, 2012: 5). The intention of this thesis was to both contribute to knowledge *and* make a practical difference in the world, hence supporting the rationale for employing a postpositivist approach utilising both quantitative and qualitative methods to gather and interpret data. This would enable a greater understanding of the relationship between the theories and data produced. Due to my positivist scientific background, I tended to lean towards a deductive approach, therefore, theory and the development of study objectives guided the research and the collection and analysis of data. However, using the process of induction, if theories arose as an outcome of this research, they were not ignored.

My subsequent training, education and personal values have influenced this research, whilst my interests and experiences have inspired the chosen methods and approaches. When considering the research strategy, numerical data was collected, quantified, and analysed. Qualitative data was interpreted and thematically analysed, which allowed an insight into the participant's thoughts and actions. This enabled an understanding of the differences between people's actions and interactions with objects and integrated human interest into the data to construct deeper knowledge and understanding. This research made use of quantitative and qualitative methods and is informed by social constructionist theory and interpretivist epistemology.

3.4.3 Symbolic interactionism and dramaturgy

Symbolic interactionism is the theoretical perspective that informs the current methodology. Symbolic interactionism (Mead, 1934; Blumer, 1986) was used as the lens through which to investigate, interpret and understand the interaction between individuals and their environment. Symbolic interactionism addresses the roles people play and the meanings people impose on objects, events, and behaviours (Crossman, 2022), in other words the meanings people attach to 'action and things' (Bryman, 2012: 716).

Launched in 1934 by Mead, and continued by Mead's student Blumer (1986), symbolic interactionism represents the relationship between 'actors' (Alvesson and Schöldberg, 2018: 71) and symbols conveyed between these actors: 'People create and continually re-create themselves in contact with others' (Alvesson and Schöldberg, 2018: 71). Symbolic interactionism deals with basic social interactions, such as 'language, communication, interrelationships and community' (Crotty, 1998: 8). In this research, symbolic interactionism was used to understand and explain what happened during the different interventions; to make sense of the actions and behaviours of the 'actors' involved in the scenarios (Alvesson and Schöldberg, 2018: 71). This perspective aligned with both my constructionist epistemology and the metaphor of simulation-based education as a *performance* where students learn to *act* or *perform* during scenarios prior to real-world interactions with patients (Talbot et al., 2010; Roberts and Talbot, 2011). A symbolic interactionism perspective allows the researcher to consider the situation from the standpoint of others, enabling an understanding of how others think and act (Crotty, 1998) from the 'point of view of the actor' (Coser, 1971: 340).

A dramaturgical approach (Goffman, 1959) informed the research, which further supported the analogy of simulation and the theatre. In 'Presentation of self in everyday life', Goffman (1959) described face-to-face *interactions* or *encounters* where participants are in each other's continuous presence. Goffman (1959) went further to explain that the activities that occur during these encounters can be termed a *performance* and those who interact or contribute during the performance can be known as the *audience*, *observers* or *co-participants* who take on *parts* during the performance. These terms can be related to everyday social situations but are also entirely relevant to simulation-based education. To reflect this, Roberts and Greene presented the analogy of simulation as theatre in 2011[10]; they claimed that simulation-based education provides 'a stage where the learners can prepare for future clinical encounters and begin to respond both emotionally and practically to the demands of the situation' (Roberts and Greene, 2011: 697). They advocate the use of drama techniques for simulation-based education, including psychodrama, sociodrama and role-playing (Roberts and Greene, 2011), in particular, the Meisner Technique, also known as the Reality of Doing (Meisner, 1987). Meisner (1987) also suggested that in order to be good at something, one had to actually *do* it, rather than *pretend* to do it. This is also true for healthcare education. Meisner (1987) constructed some simple exercises that focus on *doing*, to discover ways to work professionally and to stop *thinking* about situations and really start *acting*. The Meisner Technique involves repetition, observation, and spontaneity; using this technique, behaviour arises as a direct result of the stimuli from the environment or other actors. The Meisner technique aligns with Bandura's Social Learning Theory

[10] I wrote this paper in 2011 with my mentor Professor Debbie Roberts, where we proposed an analogy for simulation-based education based on theatre. The paper outlined the concepts of the theatre and stage (simulation laboratory); the play itself (simulated clinical experience); the actors (nursing students); audience (students watching vicariously); director (session facilitator); and the production team (technical coordinators). We suggested that performing in front of people in a safe environment, repeated practice and taking on a new role taught students to act, think and be like a nurse.

(1977a), which involves personal, environmental, and behavioural factors with a focus on observational learning and modelling. Symbolic interactionism (Mead, 1934; Blumer, 1986) is the theoretical perspective that informs the methodology and dramaturgical approach (Goffman, 1959) provides the underlying frame that supports these concepts. Table 3-2 summarises the philosophical assumptions and methodological underpinnings as well as data collection and analysis methods applied to this thesis.

Table 3-2: Philosophy, methodology and methods
(Adapted from Crotty, 1998)

Overarching theoretical framework: Social Learning Theory					
Epistemology	Theoretical perspective	Approach	Methodology	Data collection methods	Data analysis
Social constructionism	Interpretivist: Symbolic interactionism	Dramaturgical	Inductive and deductive	Mixed methods: Qual and quant • Questionnaire • Participant observation	Statistical analysis, Comparative analysis, Thematic analysis

3.5 Mixed methods research

Data were collected for this research using mixed methods, incorporating both quantitative and qualitative methods to measure and analyse data. Mixed methods research combines two or more methods and crosses the quantitative/qualitative boundaries (Sage Research Methods, 2023). Mixed methods research is an 'increasingly used and accepted approach' (Bryman, 2012: 628) used to conduct social research. The epistemological standpoint is social constructionism and the theoretical perspective informing the methodology is symbolic interactionism (Sections 3.4 and 3.5) and, as such, this study is considered social research. There are many benefits to mixing methods in social research; it enables greater validity and the ability to corroborate or triangulate findings. This approach also enables the researcher to 'offset' the weaknesses of quantitative and qualitative research while drawing on the strengths of both methodologies (Bryman, 2012: 633). Mixed methods research enables a more complete or comprehensive view of the data, while helping to explain and understand findings:

> 'Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative data in a single study…Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone' (Creswell and Plano Clark, 2007: 5).

As this PhD study investigated both behaviour and meaning (Bryman, 2012), the research has been guided by both objectivist and constructionist worldviews but sits firmly within constructionist epistemology; objective knowledge was obtained through the formation of concepts, study objectives, and deduction to produce evidence of the truth, based upon the data collected. Similarly, knowledge was constructed socially through induction and analysis of social interaction and behaviours. A mixed methods approach involving deductive, and inductive social research methods was employed.

Using mixed methods, 'data of much greater depth can be used than can typically be gathered by quantitative researchers' (Bryman, 2012: 623). This current research integrates quantitative and qualitative research methods that cross the research strategies.

3.5.1 Mixed methods study design

This study incorporated a concurrent embedded design to enhance the quantitative elements of the study with a secondary, qualitative dataset (Creswell et al., 2008). This design was used to embed a qualitative (QUAL) component during the interventions. Qualitative data were collected concurrent with the intervention, with a strong focus on exploring how the participants experienced the intervention, while the quantitative (QUANT) arm addressed the outcomes of the study with the intention of finding answers to specific research questions. Quantitative data were collected from participants pre- and post-intervention, and qualitative data was collected during the intervention (Figure 3-2).

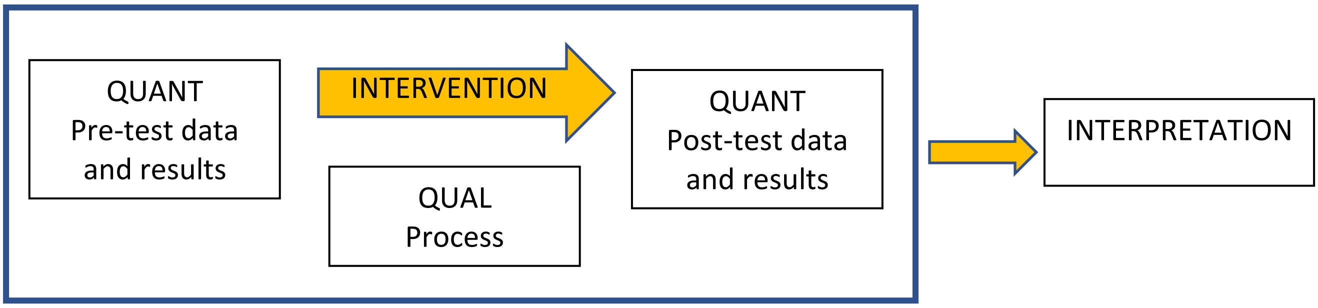


Figure 3-2: Concurrent embedded mixed methods design (Image based on Creswell et al., 2008)

The rationale for collecting qualitative data during the intervention was to validate the quantitative outcomes with qualitative 'voices' (Creswell et al., 2006: 4) of the participants; to understand the impact of the intervention, in this case, the effect of realism, on the participants. Furthermore, to try to comprehend any unanticipated participant experiences during the study, which would not be depicted in the quantitative data (Sandelowski, 1996; Creswell et al., 2006).

This research was an observational cohort study observed during three different interventions. This was not an experimental study; there was no random assignment of subjects to control or experimental groups (Parahoo, 1997). Interventions were introduced to the participants at different time-points and the impact of the interventions were measured, which is consistent with a non-randomized observational cohort study (Hong et al., 2018). This research involved more than one study group; the results from three different interventions/conditions were compared to enable a greater understanding of the social phenomena of interest with the intention of comparing and contrasting cases or experiences (Bryman, 2012).

The observational cohort study compared learners' responses to different interventions, and investigated the impact of different interventions, while the qualitative data aimed to provide an in-depth description of their experience. The independent, dependent and control variables for this research study are listed in Table 3-3 below. Repeated measures/within groups is a research design where subjects are measured two or more times on the dependent variables (Parahoo, 1997). Rather than analysing results from different participants for each condition, participants are exposed to more than one condition and are measured before, during and after each, which is the process followed for data collection in this study.

Table 3-3: Independent, dependent and control variables associated with this study

Variable	Explanation	Alignment to this research study
Independent variable (IV)	Interventions that change during the study	Modality of simulation-based education
Dependent variables (DV)	Measurements/observations gathered during the study	Knowledge Emotions Behaviour Realism Self-efficacy
Control variables (CV)	Constants that do not change during the study	Participants Setting Measurements/observations

Repeated measures/within groups was the most appropriate method as fewer participants were required; since they all participated in all three interventions. Individual differences or participant variables were also reduced, therefore enhancing internal validity of the study. Internal validity, 'the extent to which changes, if any, in the dependent variable can be said to have been caused by the independent variable alone' (Parahoo, 1997: 196). In this study, the same group of participants were involved in each intervention consecutively and responses to each condition were measured pre- and post-test to analyse whether the interventions would cause changes to the dependent variables.

As this study used mixed methods, it was important to ensure reliability and validity of the quantitative data collection tools, whilst credence was held for trustworthiness and authenticity of the qualitative findings (Bryman, 2012). Reliable and valid tools were used during the quantitative arm of the study (data collection tools are discussed in Chapter 4, Section 4.5.2). Trustworthiness of the qualitative arm of the study was confirmed by four criteria: Credibility, Transferability, Dependability and Confirmability (Lincoln and Guba, 1985).

In this study, Credibility was established using methodological and data triangulation. Methodological and data triangulation (Lincoln and Guba, 1985; Cameron, 2011) enable the results to be more generalisable to other situations (Bhandari, 2022). Triangulation was used in this research to cross-check the quantitative and qualitative findings and to capitalise on the strengths and compensate for any weaknesses in any of the methods used (Sage Research Methods, 2023).

Transferability of the unstructured observational findings was achieved using thick description (Lincoln and Guba, 1985), rather than superficial accounts, to thoroughly describe the data (Chapter 6) with enough detail to draw conclusions and potentially transfer findings to other times, settings, situations, and learners.

PhD supervisors, not involved in the research process, ensured that proper procedures were always followed. In addition, complete records were kept at all stages of the research process from selection of participants, fieldwork notes, scenario transcripts and data analysis (Bryman, 2012) to ensure Dependability of the research findings. The 'audit trail' (Nowell et al., 2017: 3), further enhanced the Confirmability criterion to ensure that the researcher remained as objective as possible and acted 'in good faith' (Bryman, 2012: 392).

Acknowledging my own personal beliefs, values, assumptions, and position (Chapter 1, Section 1.3) and embedding reflexive elements into the body of this thesis (Chapter 4), ensured the findings were shaped by the participant's thoughts and actions and not researcher bias.

Regarding authenticity of the qualitative findings (Lincoln and Guba, 1985; Bryman, 2012), the aim of this study was to investigate the effect of realism, to better understand the phenomena of interest, and make changes based on the findings to provide better simulation-based education for learners in the future. Therefore, the 'educative authenticity' (Bryman, 2012: 393) was established, to try to understand the perspectives of others in this social learning setting and make positive changes for the future.

3.5.2 The use of questionnaires for data collection

Using questionnaires to gather data in healthcare research is a predetermined, standardised, and structured method of data collection. They can be used to produce knowledge through induction:

> '…they may not only provide data that facilitate understanding of the phenomena being investigated, but can also generate data from which concepts and hypotheses can be formulated' (Parahoo, 1997: 247).

In this study, questionnaires were used in conjunction with structured and unstructured participant observation. The benefits of using questionnaires were that they were quick, convenient, and cheap to administer (Bryman, 2012). By ensuring respondents remain anonymous, questionnaires can also help to maintain participant confidentiality and they ensure consistency in questions, which are provided in the same order for each participant (Bryman, 2012). Parahoo (1997) also states that questionnaires are useful for providing data on attributes, attitudes, knowledge, beliefs, opinions, perceptions, experiences, and behaviour. In this study, five questionnaires were used to gather demographic data, plus data on emotions, knowledge, realism, and self-efficacy. Questionnaires are routinely used for gathering demographic data, for example, age, gender, occupation, education, and qualifications.

The five valid and reliable questionnaires used in this study included a combination of closed questions, rating scales and a visual analogue scale (VAS). Demographic data were collected using multiple choice questions, which offered participants a list of options for them to select the most applicable option. This was useful for collecting demographic data where there was a fixed number of response options (Parahoo, 1997): 'with a closed question they are presented with a set of fixed alternatives from which they have to choose an appropriate answer' (Bryman, 2012: 246). Three of the questionnaires included rating or Likert scales, which are also a form of closed questions, however they differ from multiple choice questions as scales are generated from statements that participants are asked to rate. Following this, each rated statement is given a score, and the total score is 'given an interpretation' (Parahoo, 1997: 258). Typically, Likert scales require the participants to use a scale to determine the extent to which they strongly agree, neither agree or disagree or strongly disagree with each statement. Two of the three questionnaires employed a five-point Likert scale, the third questionnaire employed a four-point scale (ranging from, 'not at all true' to 'exactly true'). The fifth questionnaire included visual analogue scales (VAS) (Hayes and Patterson, 1921). Using VAS, participants record their responses on a horizontal line representing a 'continuum' (Parahoo, 1997: 261) between two points, which was the case in this study:

> 'Basically, the VAS consists of a continuous horizontal line, usually of 10cm in printed length, and two descriptive phrases at the two extremities. The scale is commonly ranged from 0 (left, least extreme) to 10 (right, most extreme)'
>
> (Yeung and Wong, 2019: 1).

Participants were required to place a line or a cross on the VAS to indicate the intensity of their feelings towards the statement or terms at either end of the scale. VAS are useful for collecting feelings, attitudes, perceptions, and sensation data (Cline et al., 1992). They are also quick and easy to administer and simple for participants to understand (Cline et al., 1992).

In summary, the advantages of questionnaires involving closed questions are apparent; their predetermined structure ensured trustworthiness of the data and enabled comparisons to be made. Questionnaires completed on the same template by multiple participants allowed analysis of data to be consistent. Self-administered questionnaires are anonymous and reduce 'interviewer effect' (Parahoo, 1997: 263), which meant that reporting was more accurate and reliable. There are some noted problems associated with using questionnaires to investigate feelings and behaviours. For example, how participants say they feel and behave can be subjective and may not truly represent how they feel or what they actually do. There may also be problems associated with understanding, omission, memory, social desirability, and honesty (Bryman, 2012). The main issue with using questionnaires to gather behavioural data is whether the data relates to their actual behaviour; 'Questionnaires tap people's attitudes and reports of their behaviour, but one might legitimately question how well these relate to actual behaviour' (Bryman, 2012). Therefore, questionnaires were used to collect data relating to participant's knowledge, emotions, structured behaviours, realism, self-efficacy, and demographics. In addition, and to mitigate against the issues of using questionnaires to collect behavioural data, behaviours were also measured using unstructured participant observation research techniques, rather than a self-reported questionnaire.

3.5.3 Structured participant observation

Structured observation was used in this study to observe and interpret participant's actions and behaviours during three interventions. Structured observation is a standardised, deductive approach to participant observation that can be used to discover whether certain aspects of the phenomena being investigated are present (Parahoo, 1997). During structured observation, the researcher formulates strict 'rules' (Bryman, 2012: 272) for the observations and recording of behaviours, these rules are applied to predetermined checklists or an 'observation schedule' (Bryman, 2012: 272) with fixed categories. During structured observation, participants are observed for a fixed amount of time, using the same 'rules' (Bryman, 2012: 272). These categories are then subdivided into 'molar' or 'molecular' units of observation. Molar units are broad, overarching categories; within the broad molar categories, there can be associated molecular elements, which are more detailed and specific, allowing for more accuracy and precision in the recording of behaviours (Parahoo, 1997). However, when analysing behaviour, these terms do not refer to the size of the element; molar is not 'big' and molecular does not refer to 'small':

> 'A molecular analysis describes how reinforcement shapes and organizes continuous, moment-to-moment behaving into new higher order patterns, and a molar analysis describes how reinforcement affects averages of aggregates of different instances of the same behaviors (sic) that occurred at different times' (Shimp, 2013: 295).

In the same way that a researcher stands outside of the research process when administering questionnaires, this, too occurs with structured observation; the observer does not interfere with, or influence, the situation or behaviours that are occurring, but simply observes. Structured observation can also be used to 'quantify' (Parahoo, 1997: 317) elements or aspects of the phenomena being investigated, by suggesting either 'frequency or intensity with which it may happen' (Parahoo, 1997: 317). The observation schedule specifies the categories (molar) and elements (molecular) that are to be observed. Rating scales can also be used in structured observation to assess the quality of the activity. For example, descriptive graphic scales can be used to rate participant's actions. In this research study a predetermined, validated observation schedule was used to guide the structured participant observation. For structured observation to be reliable and valid, the observation schedule or checklist itself must be reliable and valid and reflect the required observations to truly 'represent the phenomenon' (Parahoo, 1997: 320) being explored. An appraisal of different tools and systems to guide the structured observations in this study was undertaken and is described in Chapter 4, Section 4.2. The observation schedule selected for this study was the Scrub Practitioners' List of Intra-operative Non-Technical Skills (SPLINTS) system (Mitchell et al., 2013). The selected system was 'adequately reliable' (Mitchell et al., 2012: 15) and tested for observing interactions during simulation-based education (Mitchell et al., 2012). The benefits of utilising a structured observation approach are that it is reliable, precise, accurate, and economical (Bryman, 2012; McCall, 1984).

3.5.4 Unstructured participant observation

Unstructured observation is the inductive approach to participant observation that was used to observe participants to try to understand what they were doing during the different interventions. It is flexible, holistic, and unfocussed with the intention of discovering as much about the setting, participants, and phenomenon of interest as possible:

> '…the researcher enters the field with some general ideas of what might be salient, but not of what specifically will be observed' (Given, 2008: 2).

Unstructured observation aligns well with the postpositivist perspective and social constructionist epistemology, as knowledge was co-created using this methodology and it is 'not constrained by checklists and coding schemes' (Given, 2008: 2). Using this technique, rich, detailed data were gathered about the physical setting, participants, including physical characteristics, clothing, speech, and interactions. Unstructured participant observation with a moderate level of embedded researcher participation was used during this research study to maintain a balance between insider and outsider roles. This method allowed an appropriate combination of collaboration, involvement, and the required ability to remain detached from the research and therefore remain objective.

During unstructured observation, what to observe was not pre-decided; however, categories from the structured observation schedule were layered onto the data set using a deductive process. Traditionally, vast quantities of data are produced, which can make analysis rather 'difficult, laborious and time-consuming' (Parahoo, 1997: 326), however the benefits of gaining rich data outweigh the difficulties associated with analysis. Using questionnaires for data collection has its advantages, as mentioned in Section 3.5.2, but questionnaire research also has disadvantages, including the inability to probe or collect additional data (Bryman, 2012). Therefore, unstructured observation counterbalanced the disadvantages of the self-completion questionnaires and added depth and additional data, that was not obtained from structured observation methods or from the questionnaire data. In this research study, participants were observed, and interactions audio and video recorded during the scenarios. These recordings were then transcribed, and data thematically analysed using Braun and Clarke's (2006) six-step process (Figure 3-3) to identify themes:

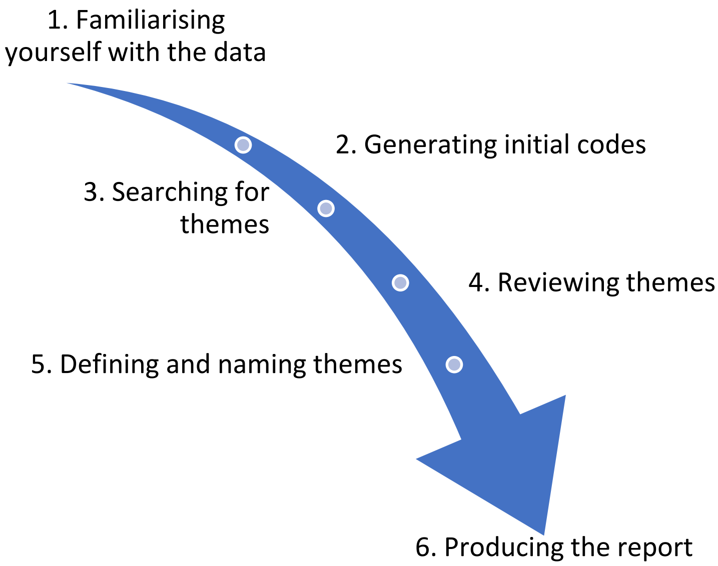


Figure 3-3: Braun and Clarke's (2006) six-step process

Reflexive thematic analysis is an interpretive approach to qualitative data analysis, which allows the identification and analysis of patterns or themes in a data set (Byrne, 2022). Reflexive thematic analysis was selected as it is an appropriate approach when utilising a constructionist epistemology (Braun and Clarke, 2019). Using reflexive thematic analysis themes were actively created by the researcher, they did not passively emerge from either data or coding: 'They are not 'in' the data, waiting to be identified and retrieved' (Braun and Clarke, 2019: 594). Themes were created and interpreted to tell 'stories' about the data (Braun and Clarke, 2019: 594). The reflexive thematic analysis approach was undertaken with reflective and thoughtful engagement with the data and reflexive and thoughtful engagement with the analytic process.

Using Braun and Clarke's (2006) approach, one acknowledges that meaning is 'not inherent or self-evident in data' (Braun and Clarke, 2021: 210). Meaning, therefore, lies within the data, but can only be extracted by the researcher's interaction and interpretation of the data. Braun and Clarke (2006) clarify that thematic analysis recognises different types of code, which can be semantic (surface, obvious, with explicit meaning) or latent (implicit, with underlying meaning). Codes represent the researcher's 'interpretations of patterns of meaning across the dataset' (Byrne, 2022: 1393). Whereas themes are 'patterns of shared meaning united by a central concept, developing out of the analytic process following coding' (Braun and Clarke, 2021: 209). These themes are 'analytic outputs', developed through and from the process of coding (Braun and Clarke, 2019: 594).

Data saturation, 'the point at which no new information, codes or themes are yielded from data' (Braun and Clarke, 2019: 202) was not sought during the process of analysing transcribed data for this research study. Data saturation aligns with a realist approach to thematic analysis, rather than an interpretivist, reflexive approach as was embedded into this current research practice. According to Braun and Clarke (2021), data saturation is not a particularly useful or theoretically coherent concept. Since data saturation was not sought, the researcher made a 'situated, interpretative judgement' about when to stop coding and move onto generating themes (Braun and Clarke, 2021: 210). It was deemed more important to gain relevant and meaningful themes, rather than gathering a specific quantity of themes or attempting to unnecessarily saturate the data. Themes and concepts were socially constructed to gain meaning from the qualitative data. The process of coding and theme extraction is outlined in more detail in Chapter 6 (Section 6.2).

In an attempt to understand and gain knowledge from learner's experiences, thoughts and behaviours, reflexive thematic analysis was an appropriate method of analysis to be used (Braun and Clarke, 2019; Kiger and Varpio, 2020). Thematic analysis can be used to search for common meanings in the data in a postpositivist, interpretivist orientation, hence fitting within the research approach adopted: 'post-positivists can use thematic analysis to focus on individuals' meanings and experiences to gain insights into the external reality' (Kiger and Varpio, 2020: 2). It was also useful as a first analytic method for novice qualitative researchers like myself (Braun and Clarke, 2006; Kiger and Varpio, 2020).

3.6 Ethical considerations

The preceding sections have provided the central epistemological ontological, and methodological position of this thesis. Chapter 4 will explore the methods utilised to collect and analyse data in more detail, in order to explore phenomena as proposed in the research questions. The next section is related to the ethical considerations associated with this research.

3.6.1 Medical ethics related to this research

Simulation-based education is not a new teaching and learning strategy for health and social care education. As discussed in Chapter 1, learners have been involved in scenarios involving real-world examples of healthcare utilising a spectrum of simulation modalities, diverse equipment and involving real people in roles for many years. As a result, ethical considerations have been reflected in simulation-based education literature in the same way that ethics have been embedded into medical and healthcare education when discussing real-patient scenarios. The Hippocratic Oath is the 'earliest expression of medical ethics' (Sioutis et al., 2021: 264). The original works of Hippocrates, (Sioutis et al., 2021; 264) date back to around 400BC (Tyson, 2001). These works, known as the Hippocratic Corpus, described duties, ethical responsibilities, plus methods, and interventions for rebalancing the body and repositioning joints. The oath refers to the responsibilities of physicians specifically 'for the benefit of the sick' (Sioutis et al., 2021: 266). The Hippocratic oath is an ethical code and a guide for medical doctors, referring to ethical values and obligations that a doctor has for their patients, for example relating to patient confidentiality, equality and knowing one's own limitations. Many medical schools traditionally required their graduates to uphold an updated version of the Hippocratic oath, by swearing to maintain ethical standards. Nowadays, the original form of the Hippocratic oath is rarely used as it is seen to be out-dated: 'More contemporary forms of the oath are usually used because medicine has evolved throughout centuries' (Sioutis et al., 2021: 265).

The Latin phrase *primum non nocere*, which features in the Hippocratic Corpus, translated means *first do no harm*; it is a well-known saying related to the medical profession. In this context, the phrase refers to refraining from using medical skills for 'malevolent purposes' (Sioutis et al., 2021: 266), for example, by harming a patient on purpose. The maxim also refers to medicine as a 'moral enterprise' (Jonsen, 1978: 828) whereby medical skills are to be used for 'human benefit' (Jonsen, 1978: 828). In this paper Jonsen (1978) also discusses the 'ethical importance of caring' (Jonsen, 1978: 828), which can be applied to both healthcare practice and research. Caring can be seen as a moral act, whereby both healthcare professionals and researchers can use their skills for the well-being of their patients and participants but in doing so, must act with morality and with 'due care' (Jonsen, 1978: 829) whilst striving for a beneficial outcome:

> 'The maxim [do no harm] could refer both to medical practices in general, calling for their continued improvement by research, and to the skills of particular practitioners, demanding continued study and upgrading' (Jonsen, 1978: 829).

Fundamentally the maxim *do no harm* can be interpreted as a positive way to *be of benefit*, urging practitioners to act as moral agents; 'urging that he or she have certain motives, intentions, and ways of judging' (Jonsen, 1978: 832).

These days the 'Four Pillars of Medical Ethics'; Beneficence, Non-maleficence, Autonomy and Justice (Beauchamp and Childress, 2001) are a more appropriate, contemporary version of the Hippocratic oath. The four pillars provide an analytical framework to examine the best course of action during ethical patient dilemmas. The four pillars, or principles, assist doctors and other healthcare professionals with their decision-making when moral or ethical situations arise in their area of practice (Gillon, 1994). The four pillars are as follows:

- ***Beneficence*** considers the balancing of benefits of treatment against risks and costs; the healthcare professional should act in a way that benefits the patient

- ***Non-maleficence*** involves avoiding the causation of harm; healthcare professionals should not harm the patient and avoid anything which is unnecessarily or unjustifiably harmful
- ***Autonomy*** respects the decision-making capacities of people and enables individuals to make reasoned informed choices
- ***Justice*** involves distributing the benefits, risks, and costs fairly; the notion that patients in similar positions should be treated in an equivalent manner.

In the same way that healthcare professionals should act with beneficence, non-maleficence, autonomy and justice, participants in this study were expected to use the same principles to guide them to the best course of action during the simulated patient scenarios.

3.6.2 Ethics of care as a moral theory

The process of gaining ethical approval is described in Chapter 4, however, here the theory of ethics of care is outlined as it provides an explanation for the ethical values that support this research study. Ethics of care suggests that moral emotions, for example, sympathy, empathy, sensitivity, and responsiveness, guide us to act properly (Copp, 2005; Held, 2006). Ethics of care values these moral emotions. It enables research that embraces trust, consideration, and care, diminishing one's own interests, in favour of the interests of those being cared for; 'acting for self-and-other together' (Held, 2006: 12). Ethics of care focuses on relationships, values, and practice (Held, 2006). During simulation-based education and research generally, we are required to attend to, and meet the needs of others, for whom we take responsibility. The ability to flourish or succeed depends fundamentally on the care that those needing it receive. The ethics of care stresses the 'moral force' of the responsibility to respond to the needs of the dependent (Held, 2006: 10). In the case of this research, the dependants were student learners, and as such, academics and researchers have a moral responsibility to act in a way that protects them and keeps them safe from harm during teaching and learning experiences at the University. The ethics of care as a moral theory supports this research. The theory places value on moral emotions, and since the research study itself investigated student learner's emotional responses to different simulation-based education scenarios, the ethics of care is highly applicable.

3.6.3 Simulation ethics

The Healthcare Simulationist Code of Ethics by Park et al. (2018) was developed to declare aspirational values for all Academics and Healthcare Professionals involved in simulation-based education. These key values are: 'Integrity, Transparency, Mutual Respect, Professionalism, Accountability, and Results Orientation' (Park et al., 2018: 2). These values guide everyone involved in healthcare education, so that we can work toward 'safe practice, improved performance, and quality of healthcare' (Park et al., 2018: 5). Lioce et al. (2018) reinforces this by stating that simulation ethics guide both simulation facilitators and learner's behaviours and conduct during simulation experiences. The overall purpose of simulation ethics is to engage learners in the learning experience to enable them to meet the learning outcomes and subsequently promote patient safety (Pinar and Peksoy, 2016). The research conducted for this thesis was guided by ethics of care theory and the values outlined in the Simulationist Code of Ethics (Park et al., 2018).

Applying moral theory to this research was essential to ensure that the research was conducted without causing harm to others, within the framework of caring for others. This research was conducted with beneficence, non-maleficence, ensuring autonomy for the student learners who participated and whilst being mindful of justice. Furthermore, scenarios and debrief involved in this research were conducted following the Simulationist Code of Ethics, with integrity, transparency, respect, professionalism, and accountability. Whilst the research was results orientated, it was conducted safely with an overall aim to improve the quality of future simulation-based education practice, which would, in turn, improve healthcare education for the benefit of patients in the longer-term. Consequently, the research was conducted to *be of benefit* (Jonsen, 1978) to academics and facilitators of simulation-based healthcare education and student learners.

3.7 Chapter summary

This chapter has introduced the overarching research question, study aim and objectives. The theoretical framework, Bandura's (1977a) Social Learning Theory, that supports this thesis was presented, followed by a discussion relating to the broad philosophical underpinnings including constructionism, symbolic interactionism as the theoretical perspective and the dramaturgical approach taken to conduct this study. Mixed methods research in relation to this study and the wider ethical considerations related to simulation-based education practice and research, along with the ethics of care were also presented. The following chapter (Chapter 4) will present the practicalities and methods of data collection undertaken, along with a description of the feasibility study, pilot study and main research study, prior to presentation of findings in Chapters 5 and 6.

CHAPTER 4 - METHODS

4.0 Chapter overview

This Chapter will describe the research process that was undertaken. It will present details, in chronological order, of the process undertaken to carry out this research including ethical approval, the feasibility study, and the subsequent reflective process that was embarked upon prior to and following the pilot study. Finally, a description of the main research study that was conducted will be presented.

4.1 Ethical approval

Ethical approval was sought in 2016. Approval was granted on 06th April 2016 from Manchester Metropolitan University's Faculty of Health and Education Academic Ethics Committee (Ethics Application number: 1299). Amendments to the ethics application were submitted in 2016 and 2017 (Appendix C). The rationale for the amendments were to include a feasibility study stage prior to the pilot study in 2016 and to update the University logos and branding in 2017. The Faculty of Health and Education Academic Ethics Committee approved the second amendment on 5th October 2017, prior to the main study taking place.

4.2 Appraisal of structured observation tools

Prior to the feasibility study, a full appraisal of tools that could have been used for the structured observation of learner's behaviours was conducted. This included a review of eleven different tools or systems for structured observation of participant's behaviours and non-technical skills. The first tool considered was the Team Emergency Assessment Measure (TEAM) by Cooper et al. (2010). This validated tool was specifically designed to assess resus and trauma team's emergency non-technical skills. TEAM (Cooper et al., 2010) provides an overview of the whole team's performance but was considered too specific towards trauma skills. The next tool considered was the CARDIOTEAM checklist (Andersen et al., 2010), a formative assessment tool for measurement of performance in multi-professional resuscitation teams. This checklist was rejected as it was not validated and only useful in cardiac arrest scenarios. The Emergency Response Performance Tool (ERPT) (Arnold et al., 2009) is a validated tool that measures time on task and a response scale for measuring participants' ability to perform tasks/procedures. This tool was also rejected as it was too specific and only useful in cardiac arrest scenarios. The Mayo High Performance Teamwork Scale (MHPTS) by Malec et al. (2007) was also considered. MHPTS is used by participants in training to reflect on and evaluate their performance as a team. This scale was rejected as it is completed by the participant, not a researcher so was deemed inappropriate for the purpose of this study. Non-technical skills for surgeons (NOTSS) (Yule et al., 2006) is a behaviour rating system that enables consultant surgeons to give feedback to colleagues and trainees based on structured observations of the non-technical aspects of performance during intraoperative surgery. This system was also rejected as specific training provided by The Royal College of Surgeons of Edinburgh is required prior to using the system. Furthermore, it is specifically aimed at rating surgeons' behaviours, so was considered too specific. The Anaesthetists' Non-Technical Skills (ANTS) system by Flin et al. (2010b) was developed to provide the anaesthetic community with a framework for describing non-technical skills and as a tool to guide their assessment in an explicit and transparent manner (Flin et al., 2010b). This system was again too specific as it was aimed at rating anaesthetists' behaviours. Further research revealed the non-technical skills system for assessing pilots' crew resource management (CRM) skills, known as NOTECHS (Flin et al., 2003). NOTECHS comprises four Categories: Co-operation, Leadership and Managerial Skills, Situation Awareness and Decision Making. While these Categories were appropriate, the underlying Elements and language used were specifically aimed at airline pilots and contained very specific elements related to aviation. Furthermore, NOTECHS did not list Communication as a separate Category as the authors stated that communication skills were inherent in all four Categories and the listed behaviours all involved communication (Flin et al., 2003). The next system considered was the Scrub Practitioners' List of Intra-operative Non-Technical Skills (SPLINTS) (Mitchell et al., 2013), which is a training aid designed to rate scrub-practitioners' non-technical performance; it is used to give structured feedback after performance. SPLINTS comprised of three Categories, each with three associated Elements: Situation Awareness (Gathering information, Recognising and understanding information, Anticipating), Communication and Teamwork (Acting assertively, Exchanging information, Co-ordinating with others) and Task Management (Planning and preparing, Providing and maintaining standards, Coping with pressure). This system included communication as a separate Category with teamwork and the behaviours observed were generic, so could be translated to other healthcare professionals, in addition to scrub-practitioners. The next tool appraised was a reliable and valid tool comprised of a list of tasks derived from the paediatric advanced life support (PALS) treatment algorithms (Donoghue et al., 2010). This tool scored tasks with a minimum of zero and maximum of two points with the goal of measuring whether tasks were performed at all, whether they were performed well, in a correct sequence and in a timely manner. This tool, however, was too task-orientated and only appropriate for measuring skills related to resuscitation scenarios. The Observed Skill-based Clinical Assessment Tool for Resuscitation (OSCAR) by Walker et al. (2011) is a reliable and valid tool designed to evaluate six behavioural domains (Communication, Co-operation, Coordination, Monitoring/Situation awareness, Leadership and Decision-making) specifically related to three core team-members in a resuscitation team (Anaesthetist, Physician and Nurse). It is more detailed than the other tools/systems appraised and would provide more insight into resuscitation team behaviours but was also considered to take a long time to complete and was not generic enough to be used outside of a resuscitation team situation. Finally, the Simulation Module for Assessment of Residents Targeted Event Responses (SMARTER) (Rosen et al., 2008) was explored to check whether it would be appropriate for the purposes of this study. SMARTER is a measurement tool that captures performance during simulation. It takes the form of an event-based checklist, which is ordered in time and the associated responses are grouped for each event. A check box is provided for the rater to mark whether or not the participant performed the behaviour. Although it was developed for medics, SMARTER could be translated to other healthcare professionals. However, the tool did not provide enough detailed data to be useful.

After careful consideration and exploration, the SPLINTS system (Mitchell et al., 2013) was deemed most suitable for the purposes of this research. SPLINTS provided a structured approach with opportunity for both quantitative and qualitative data collection, it was translatable to other healthcare professionals and provided an overview of the whole group's performance. Additionally, the Categories and Elements were appropriate for undergraduate student learners. The appraisal of structured observation tools can be found in Appendix D.

4.3 Feasibility study

A feasibility study took place in April/June 2016. The aim of the feasibility study was to assess the practicalities of the proposed research. It was used to test some of the chosen measurement scales and tools, and to calculate the time taken to complete them and gain feedback from participants in order to improve the research process.

4.3.1 Feasibility study objectives

- To test measurement scales and tools to assess whether they were appropriate for the participants and usable by the researcher
- To test the measurement scales and tools to ensure they yielded useful data
- To measure the time taken to complete two of the self-reported scales (General Self-Efficacy Scale (GSES) (Schwarzer and Jerusalem, 1995) and Geneva Emotion Wheel (GEW) (Scherer, 2005; Scherer et al., 2013)
- To gain feedback from participants to improve study feasibility

4.3.2 Feasibility study rationale

It was important to assess the GSES (Schwarzer and Jerusalem, 1995) and GEW (Scherer, 2005; Scherer et al., 2013) in order to discover how long these scales took to complete and to assess whether they yielded useful data. As the scales would be completed by student learners, it was imperative to discover from the learners themselves whether they felt that these scales were easy to understand and if they could suggest any changes or improvements to enhance the usability. The GEW, in particular, was an unusual circular design, as opposed to a traditional linear design. It also had a non-traditional rating scale consisting of circles of increasing size, which users would not have been accustomed to; most participants of research would be familiar with completing linear, numeric scales previously. It was, therefore, necessary to discover if users were able to successfully understand the instructions for the emotion wheel and complete it without difficulty. In addition, it was important to use the feasibility study to assess whether the rating system, which would be used to structure the observations and assess participant's behaviours and non-technical skills, was onerous to complete by the researcher and if it would yield useful data. As discussed in Section 4.2, the Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) system (Mitchell et al., 2013) was selected for the purpose of structured observations. Feasibility study research questions (RQs) were generated using SPIDER (Cooke et al., 2012) to frame the questions of interest (Table 4-1).

Table 4-1: Feasibility study: RQ development (SPIDER, Cooke et al., 2012)

Sample	Student learners
Phenomenon of Interest	1. To discover how long the GSES and GEW took to complete 2. To assess ease of understanding and suggestions for improvements to enhance usability 3. To trial the GSES, GEW to discover if they yielded useful data
Design	Qualitative interviews Quantitative analysis of data
Evaluation	Outcomes measures: 1. Time taken to complete scales (GSES and GEW) 2. Participant's verbal suggestions for improvements (GSES and GEW) 3. Data analysis and interpretation (GSES, GEW, SPLINTS)
Research type	Mixed methods

4.3.3 Feasibility study method

The purpose of the engagement with student learners (n=13) was to discover their perspective and suggestions prior to the development of the pilot study and main research study. The researcher attended a lecture, which was taking place one week prior to the timetabled simulation sessions. Second year nursing students were invited by the researcher to participate in the feasibility study; they were informed that participation was optional and voluntary. These students were known to the researcher and had previously been taught by her. A convenience sample of thirteen second year nursing students volunteered to participate in the feasibility study over two dates as part of their Academic programme. They completed the GSES (Schwarzer and Jerusalem, 1995) and GEW (Scherer, 2005; Scherer et al., 2013) prior to entering a simulated clinical scenario. Participants were instructed to select only the emotions that they were feeling at the time and mark the intensity on the GEW. They then entered the scenario in small groups of approximately four student learners and the researcher observed from behind mirrored glass. The researcher rated the participant's behaviours and compiled written feedback in real-time during the scenario using the structured SPLINTS system (Mitchell et al., 2013). Immediately after they had finished the scenario, participants completed the GEW, again marking only the intensity of the emotions they were feeling at that time on the GEW (Scherer, 2005; Scherer et al., 2013). The thirteen students who volunteered for the feasibility study were not included in the main research study.

4.3.4 Feasibility study results

Results from thirteen second year nursing student learner's experiences are noted below associated with each of the research questions.

4.3.4.1 Feasibility RQ1. Time taken to complete scales (GSES and GEW)

The time taken by participants to complete the GSES (Schwarzer and Jerusalem, 1995) and the GEW (Scherer, 2005; Scherer et al., 2013) prior to the scenario was 3-6 minutes. The maximum time taken to complete the GEW after the scenario was 3 minutes.

4.3.4.2 Feasibility RQ2. Participant's verbal suggestions for improvements to enhance usability of scales (GSES and GEW)

No participants made suggestions on how to improve the GSES (Schwarzer and Jerusalem, 1995) or the GEW (Scherer, 2005; Scherer et al., 2013). However, positive comments were received from the participants, who, for example, stated that the GSES (Schwarzer and Jerusalem, 1995) was 'straightforward' and 'easy to understand'. The circular design of the GEW (Scherer, 2005; Scherer et al., 2013) was complimented, especially the circles to indicate increasing level of intensity, which participants felt made it 'easy' to understand and complete. They advocated the use of clear, verbal instructions rather than written instructions as they said that they would not read written instructions. The results from the GSES (Schwarzer and Jerusalem, 1995), GEW (Scherer, 2005; Scherer et al., 2013) and SPLINTS (Mitchell et al., 2013) are presented in below in Section 4.3.4.3.

4.3.4.3 Feasibility RQ3. Data analysis and interpretation (GSES, GEW and SPLINTS)

Quantitative data produced was descriptive and considered to be useful for analysing the participants' self-efficacy and emotions.

Participant's self-efficacy

The GSES (Schwarzer and Jerusalem, 1995) is a scale used to assess a general sense of perceived self-efficacy with the aim of predicting a person's ability to cope with daily hassles as well as their ability to adapt after experiencing stressful life events (Schwarzer and Jerusalem, 1995). Individual GSES scores are calculated by adding up individual's responses to ten statements to provide a total score. The GSES scores can range from 10 to 40 points. During the feasibility study, the GSES was completed before participation in the simulation activity. Scores for each participant are shown in Table 4-2.

Table 4-2: Feasibility Study - Participant's GSES scores

	Statement										
Participant ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total score**
160411_1	4	3	3	3	2	4	3	3	4	3	**32**
160411_2	3	3		3	3	3	3	3	3	3	**27**
160411_3	4	2	3	3		4	3	3	3	3	**28**
160411_4	3	4	3	3	3	3	3	2	3	3	**30**
160411_5	3	3	3	2	2	3	2	3	3	3	**27**
160411_6	3	3	3		2	3	2	3	3	3	**25**
160411_7	3	3	3	2	3	3	3	4	3	3	**30**
160413_1	3	2	3	2	2	3	2	3	3	3	**26**
160413_2	3	3	3	3	3	4	3	3	3	4	**32**
160413_3	3	2	3	3	3	3	2	3	3	3	**28**
160413_4	3	2	3	3	3	3	3	3	3	3	**29**
160413_5	3	3	3	2	2	3	4	4	2	2	**28**
160413_6	3	3	3	3	3	4	3	3	3	3	**31**
Median self-efficacy score:											**28**

NB. Grey squares show missing data.

Figure 4-1 below shows the distribution of total scores for each participant. The median self-efficacy score for the group was 28.

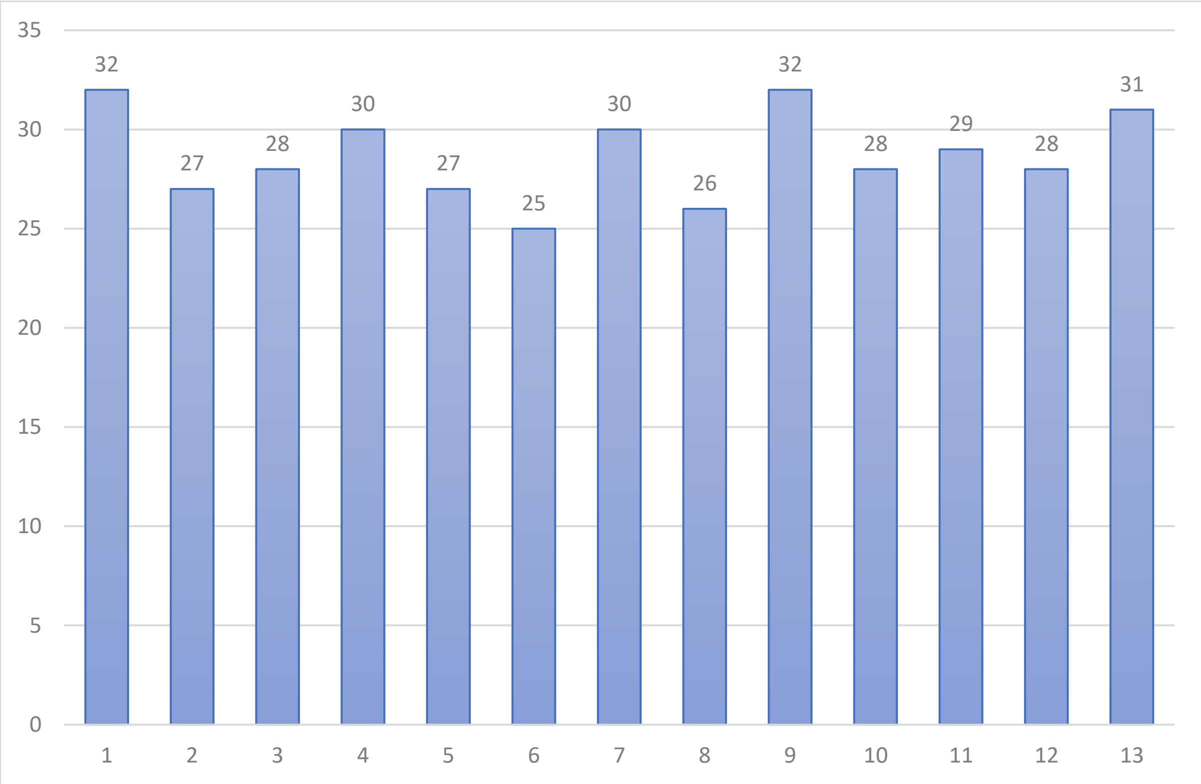


Figure 4-1: Feasibility study – Distribution of GSES score for each participant

To calculate high or low self-efficacy, Schwarzer (2005) recommends the establishment of groups on the basis of the empirical distributions of a particular reference population; 'one could do a median split, which is to dichotomize the sample, for example at the cut-off point of 30 (if this is near the median in your sample)' (Schwarzer, 2005: 2). Results from the GSES found that the feasibility group median self-efficacy score was 28. Therefore, based on the group median score from this feasibility study, a score of 28 will be considered to distinguish between participants with low (below 28) or high (above 28) self-efficacy, however, this would be confirmed following the pilot study.

Three participants each left one statement blank on the scale (shown by a grey square on Table 4-2). Schwarzer (2005) states that it is acceptable to calculate a GSES score 'as long as no more than three items on the 10-item scale are missing' Schwarzer (2005: 2), so these participants' data have been included. There is no explanation as to why these participants skipped these statements. To mitigate this in the future, clear instructions to complete an answer for each statement will be given.

Participant's emotions

Results from the GEW found that the highest scoring positive pre-simulation emotion was Interest, and the highest scoring positive post-simulation emotion was Relief. Fear was the highest scoring negative pre-simulation emotion, and Regret was the highest scoring negative post-simulation emotion.

Table 4-3: Feasibility study – Intensity of participant's emotions pre- and post-scenario

	Positive emotions																			
	Interest		Amusement		Pride		Joy		Pleasure		Contentment		Love		Admiration		Relief		Compassion	
ID	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
160411_1	4					3					3	3						5		
160411_2	5	5				4		4										5		
160411_3	4	5	3	4	3	3	2	2	2	2	2	3	1	3	1	3	2	4	3	3
160411_4	5						4						5					4		
160411_5	2					1		1								3		5		
160411_6	4	5		4		4	3	4		4		4						5	5	5
160411_7	5	5														4			4	5
160413_1	5	5				4										3				
160413_2	5	5		3		5		4	3	5		3						5		
160413_3	4	4		4														5		
160413_4	4		3	3						3								5		
160413_5			2			4				3								5		
160413_6	3	5				5		5										5		

	Negative emotions																			
	Sadness		Guilt		Regret		Shame		Disappointment		Fear		Disgust		Contempt		Hate		Anger	
ID	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
160411_1		4				4			2	4	4									
160411_2										1	4									
160411_3	1	2	1	1	1	3	1	1	1	3	3	2	1	1	1	3	1	1	1	1
160411_4		2		3		4		4		5	4									5
160411_5				2		2					5	3								
160411_6	4	2									4	2								
160411_7	1			3				2			4	5								
160413_1		1						2		1	3									
160413_2											4									
160413_3											3									
160413_4						2					4									
160413_5						2					4									
160413_6											3									

From Table 4-3 above, it is noticeable that one participant (ID: 160411_3) misunderstood the verbal instructions and rated all of the emotions pre- and post-simulation. The data obtained from the GEW, therefore, is diverse and spread over all 20 emotion families. A decision needed to be made as to how the GEW should be used. Options are, when using the GEW, to ask participants to choose only the emotions that they are feeling (as trialled in this feasibility study) or to ask participants to rate the intensity of all the emotions present on the wheel to gain explicit ratings for all emotions (as demonstrated by one participant in the feasibility study). Based on this feasibility study, it was decided for the pilot and main research study to ask participants to rate all of the emotions in the GEW, and to ask them to select the small square inside the inner-most part of the wheel to denote 'not applicable', where required. This would then give pre- and post-scenario comparison data across all twenty emotion families.

The increase in positive low-control emotions, for example, Relief (Figure 4-2) and the negative low-control emotions demonstrated in this feasibility study, for example, Sadness, Guilt, Regret, Shame and Disappointment were interesting. This further emphasised the need to investigate whether the patterns of pre/post emotions have commonality between scenarios depicting different simulation modalities.

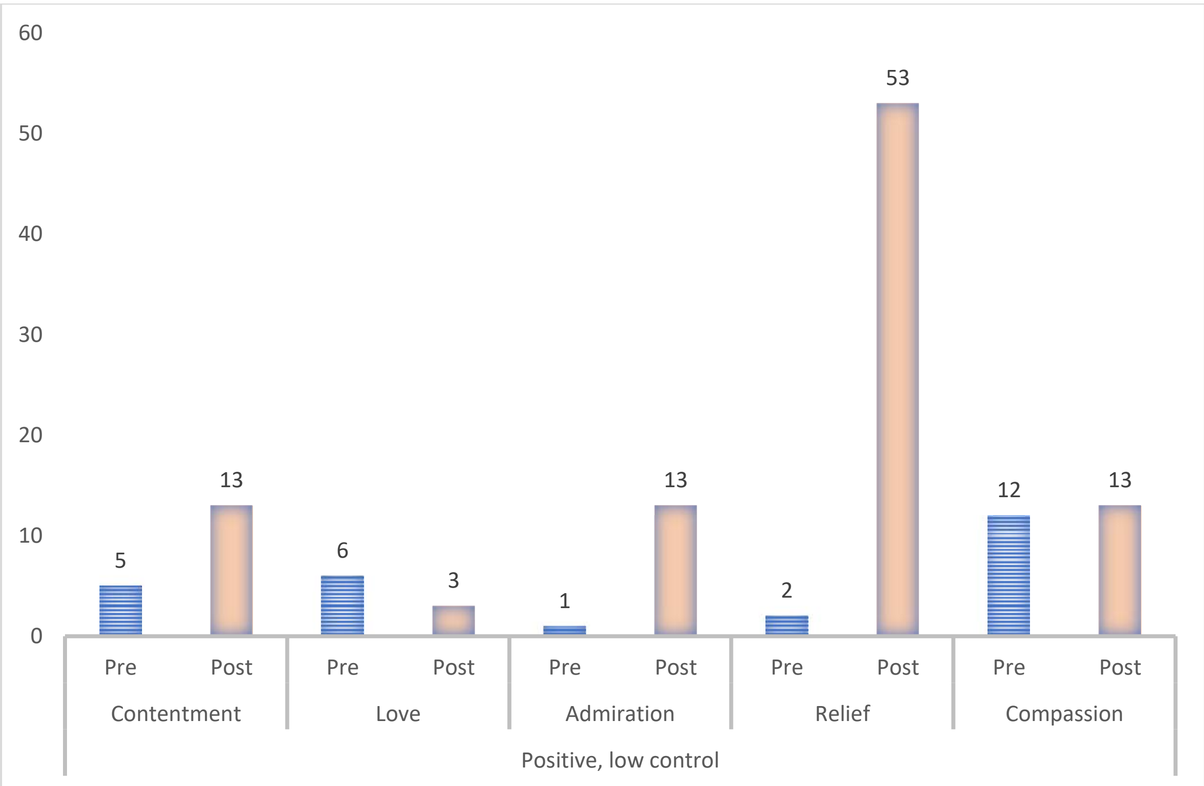


Figure 4-2: Feasibility study – GEW (positive, low control) data (pre and post scenario)

Participant's behaviours

Qualitative (observational) data gathered by the researcher was deemed appropriate for assessing participant behaviour and non-technical skills. However, during the feasibility study, the researcher was also acting in role as a simulated relative and answering the telephone in the control room during the scenario. This proved particularly challenging as important interactions to be noted on the SPLINTS system (Mitchell et al., 2013) were being missed whilst the researcher was participating in-role during the simulation. The SPLINTS data collection was abandoned during the study as it was not feasible to collect observational data at the same time as participating in the scenario.

4.3.5 Feasibility study conclusion

The feasibility study demonstrated that the use of the selected scales and tools was feasible for a larger experimental research study; they yielded useful data that could be analysed to produce deductive arguments (Section 4.3.4.3). However, it was discovered that it was impossible to complete the SPLINTS system (Mitchell et al., 2013) to gather observational data whilst participating in the scenario.

The participants made no suggestions on how to improve or enhance their ability to complete the GSES (Schwarzer and Jerusalem, 1995) and GEW (Scherer, 2005; Scherer et al., 2013) scales, only commenting positively on the design and ease of completion. The time taken to complete the scales indicated the time allocation required for completion of these scales in the main research study. Observations and reflections on the use of the SPLINTS system (Mitchell et al., 2013) proved useful and would impact positively on the way in which the main research study would be conducted. It was also recognised, following the feasibility study, that participants' knowledge should be assessed both pre- and post-scenario, to determine if there had been a knowledge gain as a result of the scenarios. This data would be compared between three different simulation modalities. Demographic data was not collected as it was out of scope of the feasibility study but would need to be collected from participants in the main research study; a relevant questionnaire was designed for this purpose.

4.3.6 Personal reflection on the feasibility study

Following the feasibility study, I took time to reflect and draw conclusions. I used Kolb's (1984) experiential learning cycle to provide a structured method for reflecting on, and learning from, a ***concrete experience****, in this case, the feasibility study.*

Reflections*: <u>What worked well</u>? The GSES and the GEW worked well. The feasibility study provided some useful data regarding the time taken to complete the GSES and GEW, which I could apply to the main research project. It also provided some useful feedback from the participants; they did not find the scales onerous to complete.*

<u>What didn't work well</u>? One participant did not follow the verbal instructions for the GEW and rated all twenty emotions. This was not a negative experience as it enabled me to see the potential for the GEW in gathering data from all participants across all emotion families, with direct comparison pre- and post-scenario. However, there were some negative implications, namely my inability to successfully complete the SPLINTS system.

Abstract conceptualisation*: Instead of dwelling on the negatives, I decided to learn from this experience and use the knowledge to improve my research process. I recognised that I was trying to do too much at once; I was trying to be a researcher and an active participant in the scenario, and this was impossible. I needed to generate an alternative plan and focus on the research. I had options, 1. Train another person to act in role as an embedded facilitator/relative during the scenarios. 2. Record the scenarios for analysis in greater depth later. 3. Employ an independent researcher to observe and rate participant's behaviours during the scenarios in real-time. The sensible options were 1 and 2. I decided to ask others to facilitate the scenarios as well as record and retain the scenarios for analysis at a later date. This was imperative in the main research study, so that they could be reviewed, and the participant's behaviours and non-technical skills assessed after the scenarios, rather than in real-time. This way I could focus on the research, rather than the teaching and learning process. Furthermore, if the scenarios could be re-visited, the behaviours could be interpreted in greater depth.*

Active experimentation*: I knew I needed to put this plan into action during the pilot study. This would give me an opportunity to test out my concepts, record the scenarios, check camera angles, sound levels and pilot test the demographic data and knowledge questionnaires. Any lessons learnt from the pilot study could then be applied to the main research study.*

4.4 Pilot study

A pilot study was conducted in October 2016; this was a pilot of the proposed main research study to investigate the overarching phenomenon of interest: 'Does realism effect undergraduate student learner's engagement and emotional response during simulation-based education?' The aim of the pilot study was to test the quality, efficiency, and processes (Malmqvist et al., 2019), prior to the main research study.

4.4.1 Pilot study objectives

- To pilot test questionnaires and scales during three different scenarios
- To pilot test the recording of scenarios for analysis later

Pilot study RQs were generated in the same way as the feasibility study RQs, using SPIDER (Cooke et al., 2012) to frame the questions of interest (see Table 4-4).

Table 4-4: Pilot study RQ development (SPIDER, Cooke et al., 2012)

Sample	Student learners
Phenomenon of Interest	1. To improve the research quality, efficiency, and processes prior to the main research study 2. To pilot test the knowledge, and demographic questionnaires as well as the GSES and GEW 3. To pilot test three different scenarios (Manikin, Human SP and Paper-case)
Design	Quantitative analysis of data Qualitative interpretation data
Evaluation	Outcomes measures: 1. Data collection and analysis (demographic and knowledge questionnaires, GSES and GEW) 2. Evaluation of A/V recording, camera positions and sound quality 3. Reflections on the scenarios and lessons learnt prior to main research study
Research type	Mixed methods

4.4.2 Pilot study method

The researcher attended a lecture, which was taking place one week prior to timetabled simulation sessions. Second year pre-registration MSc in Physiotherapy students were invited by the researcher to participate in the pilot study; they were informed that participation was optional and voluntary. These students were unknown to the researcher and had not been previously taught by her. Seven second year student learners enrolled on the pre-registration MSc in Physiotherapy programme volunteered to participate in the pilot study. They were engaged in simulation-based education as part of their Academic programme of studies, which gave an opportunity to pilot test the research process with a convenience sample of student learners. They were asked to complete the GSES (Schwarzer and Jerusalem, 1995) to gain data on their self-efficacy. They also completed the GEW (Scherer, 2005; Scherer et al., 2013) scale prior to and immediately after engaging in three different simulated scenarios (Manikin scenario, Human SP scenario and Paper-case, which are described in detail later in Section 4.6). They were instructed to note the intensity of all twenty emotions on the GEW pre- and post-scenario. The participants also completed a knowledge questionnaire before and after the scenarios and a demographic questionnaire, which included questions relating to their gender, age, academic qualifications, and occupation. The seven students who volunteered for the pilot study were not included in the main research study.

4.4.3 Pilot study results

Results of the pilot study are noted below, including personal reflections, which helped shape the main research study and develop a robust research process.

4.4.3.1 Pilot study RQ1. Data collection and analysis (demographic and knowledge questionnaires, GSES, GEW)

Data were collected prior to, during and after the three scenarios, the results and analyses are presented below.

Demographic questionnaire

100% of the participants (n=7) were female aged 21-30 (n=5, 71%) and 31-40 (n=2, 29%). Five (71%) had a Batchelors degree, while two (29%) of the participants had Masters level qualifications. Four (57%) worked in the public sector and three (43%) were full-time students.

Participant's knowledge

Knowledge scores were gathered using a visual analogue scale (VAS) directly linked to the session learning outcomes pre- and post-scenarios (the knowledge VAS is described later in Section 4.5.2). The participants showed no knowledge gain following engagement with the simulation with a human SP and the paper-case, however, knowledge increased by 3% following the scenario with a manikin (see Figure 4-3 below).

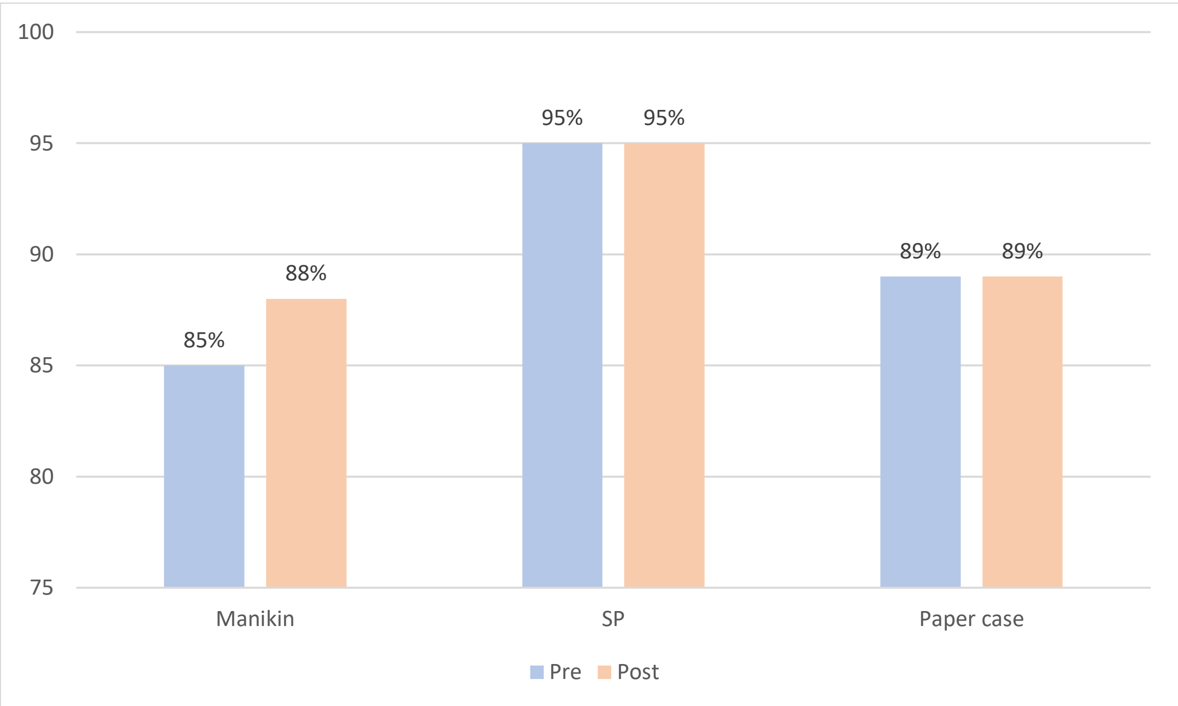


Figure 4-3: Pilot study - Participant's knowledge (pre and post scenario)

Participant's self-efficacy

GSES was completed before participation in the simulation scenarios. Scores for each participant are shown in Table 4-5 and distribution of scores in Figure 4-4.

Table 4-5: Pilot study – Participant's GSES scores

	Statement										
ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Score**
1	3	3	3	2	3	3	3	3	3	2	**28**
2	2	2	3	3	3	4	3	3	4	3	**30**
3	3	3	3	3	2	4	2	3	4	3	**30**
4	3	3	3	3	3	3	3	2	3	3	**29**
5	3	3	4	4	4	3	4	4	3	4	**36**
6	3	2	3	3	3	3	3	3	3	3	**29**
7	3	3	4	3	3	4	3	4	3	4	**34**
Median self-efficacy score:											**30**

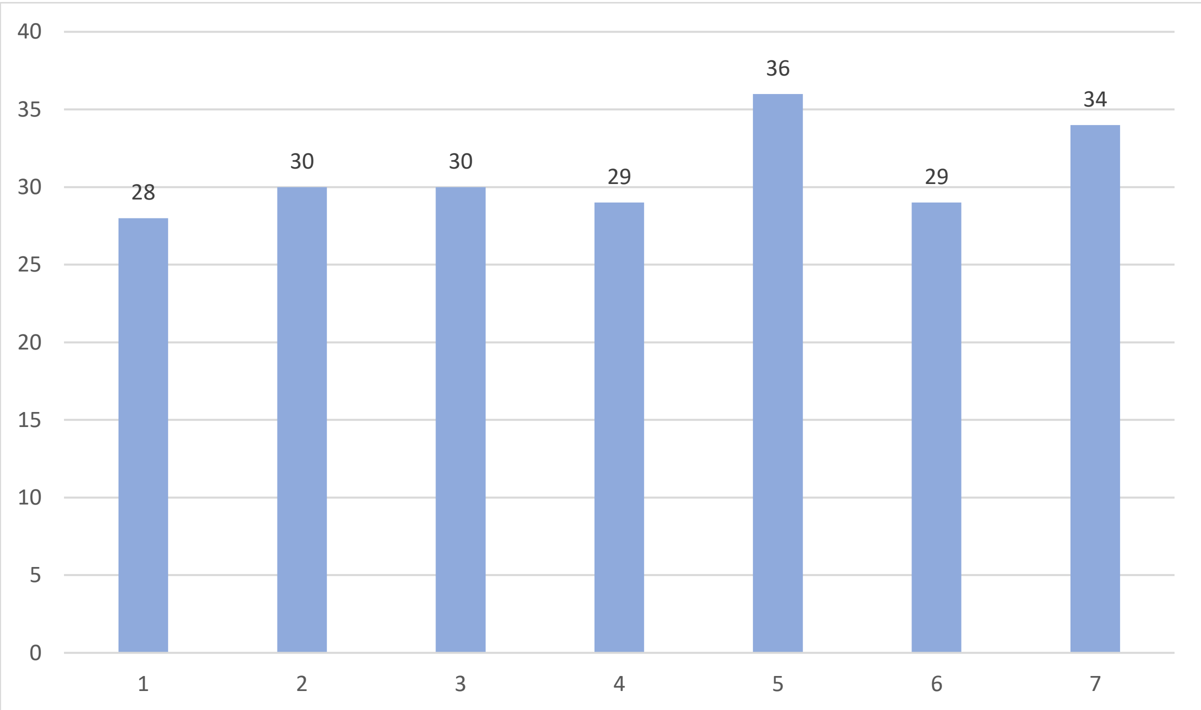


Figure 4-4: Pilot study – Distribution of GSES score for each participant

Based on the group median score from the feasibility study (28) and pilot study (30), a decision was made that a GSES score of 29 will be used in the main study to distinguish between participants with low (below 29) or high (above 29) self-efficacy. In this pilot study, most participants (6/7) were perceived to have high self-efficacy and be able to cope with daily hassles and stressful life events.

Participant’s emotions

The GEW was completed by all participants prior to and following engagement with three different simulation scenarios. Participants rated all twenty emotions in the wheel. Results are shown in Table 4-6.

Table 4-6: Pilot study – Intensity of participant's emotions pre- and post-scenario

	Positive, high control									
	Interest		Amusement		Pride		Joy		Pleasure	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
SUM	74	76	25	41	17	38	34	34	36	40
MEAN	5.7	5.8	1.9	3.2	1.3	2.9	2.6	2.6	2.8	3.1
Sim (manikin)	21	23	7	14	8	15	8	8	13	10
Paper case	31	30	11	13	7	11	14	11	14	14
Sim (SP)	22	23	7	14	2	12	12	15	9	16
	Positive, low control									
	Contentment		Love		Admiration		Relief		Compassion	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
SUM	48	47	21	25	27	21	10	46	17	44
MEAN	3.7	3.6	1.6	1.9	2.1	1.6	0.8	3.5	1.3	3.4
Sim (manikin)	21	16	10	8	11	5	6	18	6	17
Paper case	14	15	6	8	10	10	1	14	9	17
Sim (SP)	13	16	5	9	6	6	3	14	2	10
	Negative, low control									
	Sadness		Guilt		Regret		Shame		Disappointment	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
SUM	8	16	9	14	3	16	2	8	8	11
MEAN	0.6	1.2	0.7	1.1	0.2	1.2	0.2	0.6	0.6	0.8
Sim (manikin)	8	8	6	6	3	10	1	3	6	6
Paper case	0	5	1	3	0	5	0	1	2	3
Sim (SP)	0	3	2	5	0	1	1	4	0	2
	Negative, high control									
	Fear		Disgust		Contempt		Hate		Anger	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
SUM	30	11	2	0	7	8	1	2	4	2
MEAN	2.3	0.8	0.2	0.0	0.5	0.6	0.1	0.2	0.3	0.2
Sim (manikin)	15	5	2	0	3	4	1	0	4	2
Paper case	9	3	0	0	3	0	0	0	0	0
Sim (SP)	6	3	0	0	1	4	0	2	0	0

The highest scoring positive emotion reported both pre- and post-simulation was Interest (Figure 4-5).

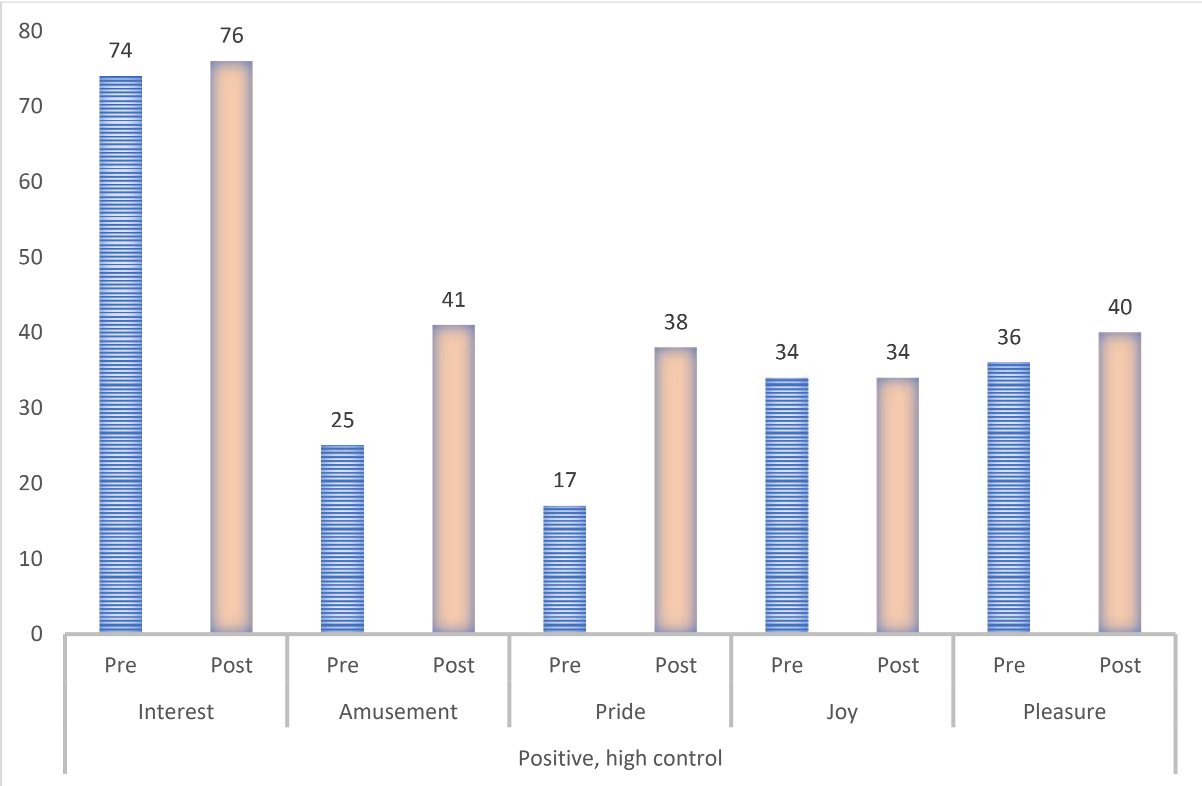


Figure 4-5: Pilot study – Intensity of participant's positive, high control emotions (pre and post simulation)

Of the positive, low control emotions, Relief and Compassion intensity increased the most following simulation (Figure 4-6).

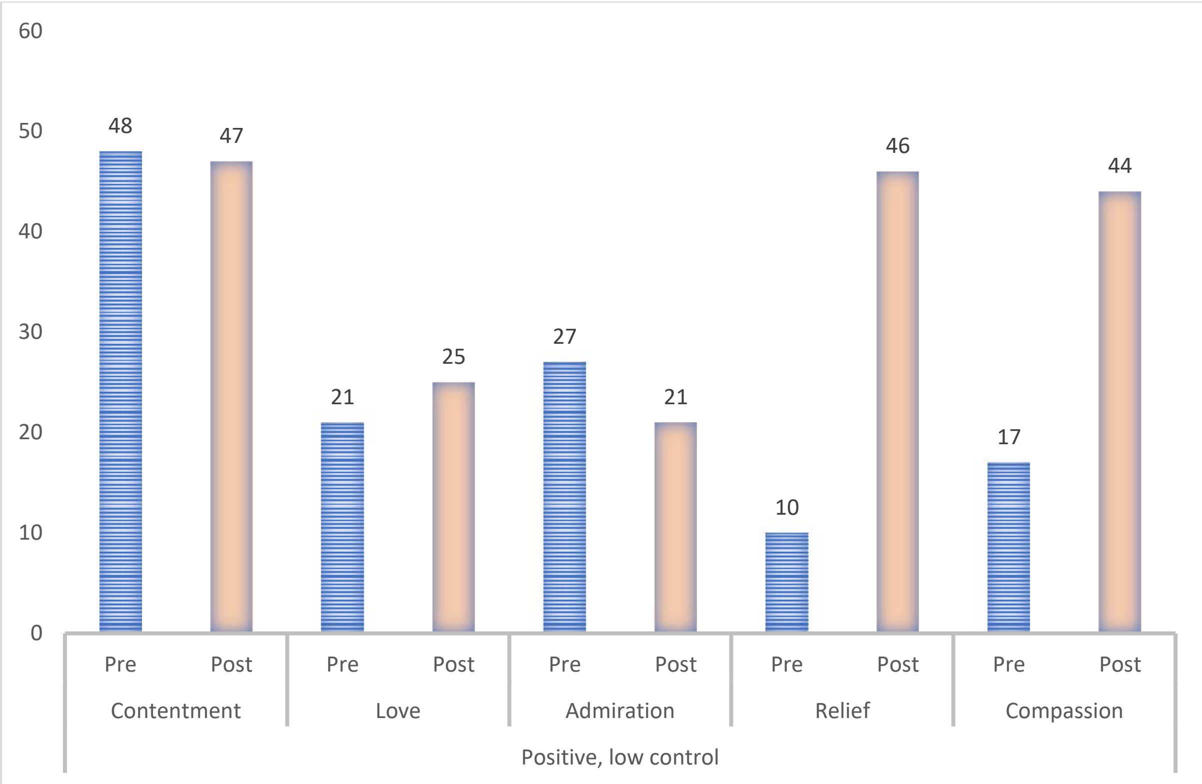


Figure 4-6: Pilot study - Intensity of participant's positive, low control emotions (pre and post simulation)

Fear was the highest scoring negative (high control) emotion reported pre-simulation (Figure 4-7) and Regret and Sadness were the equal-highest scoring negative (low control) emotions post-simulation (Figure 4-8).

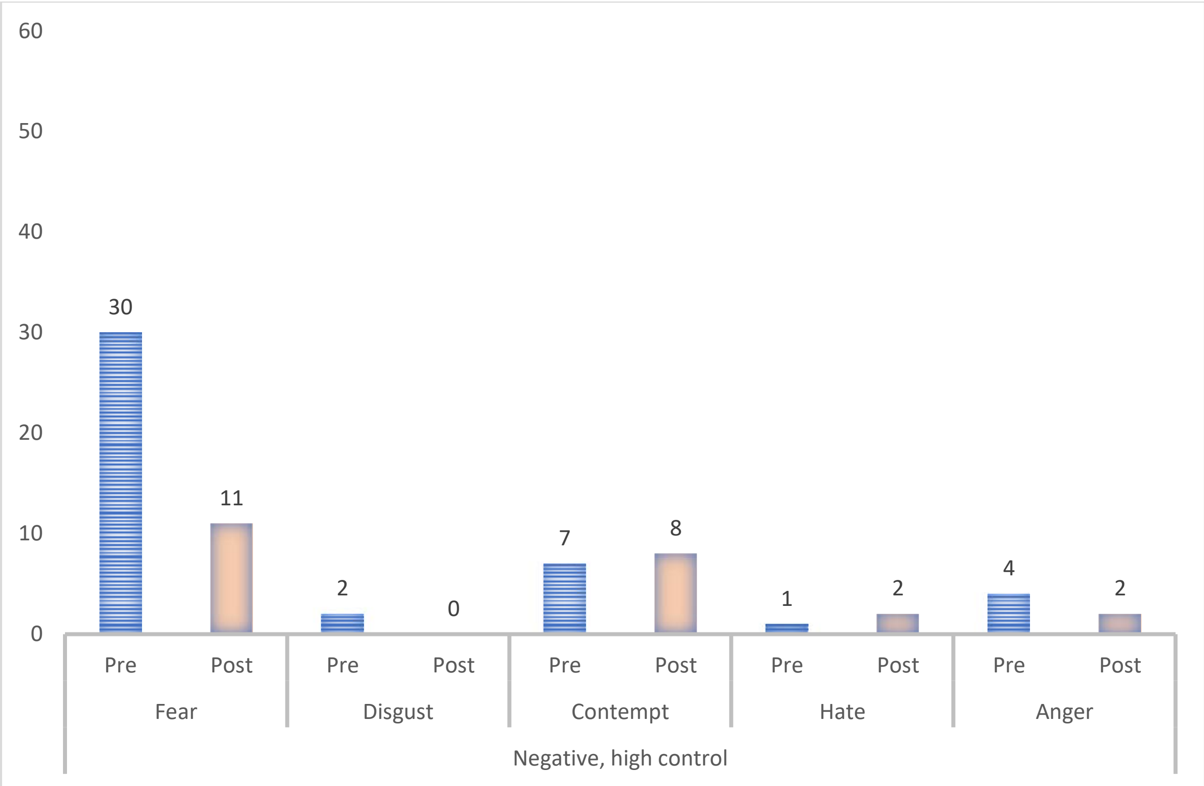


Figure 4-7: Pilot study - Intensity of participant's negative, high control emotions (pre and post simulation)

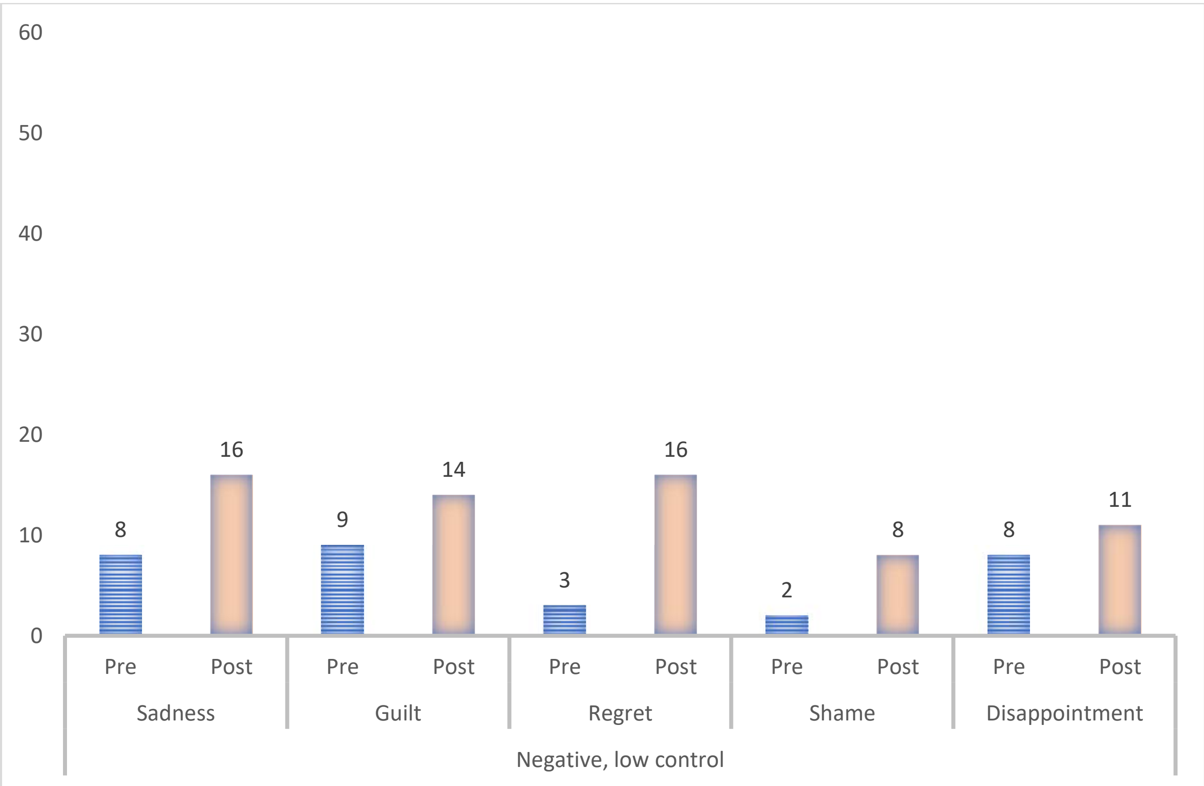
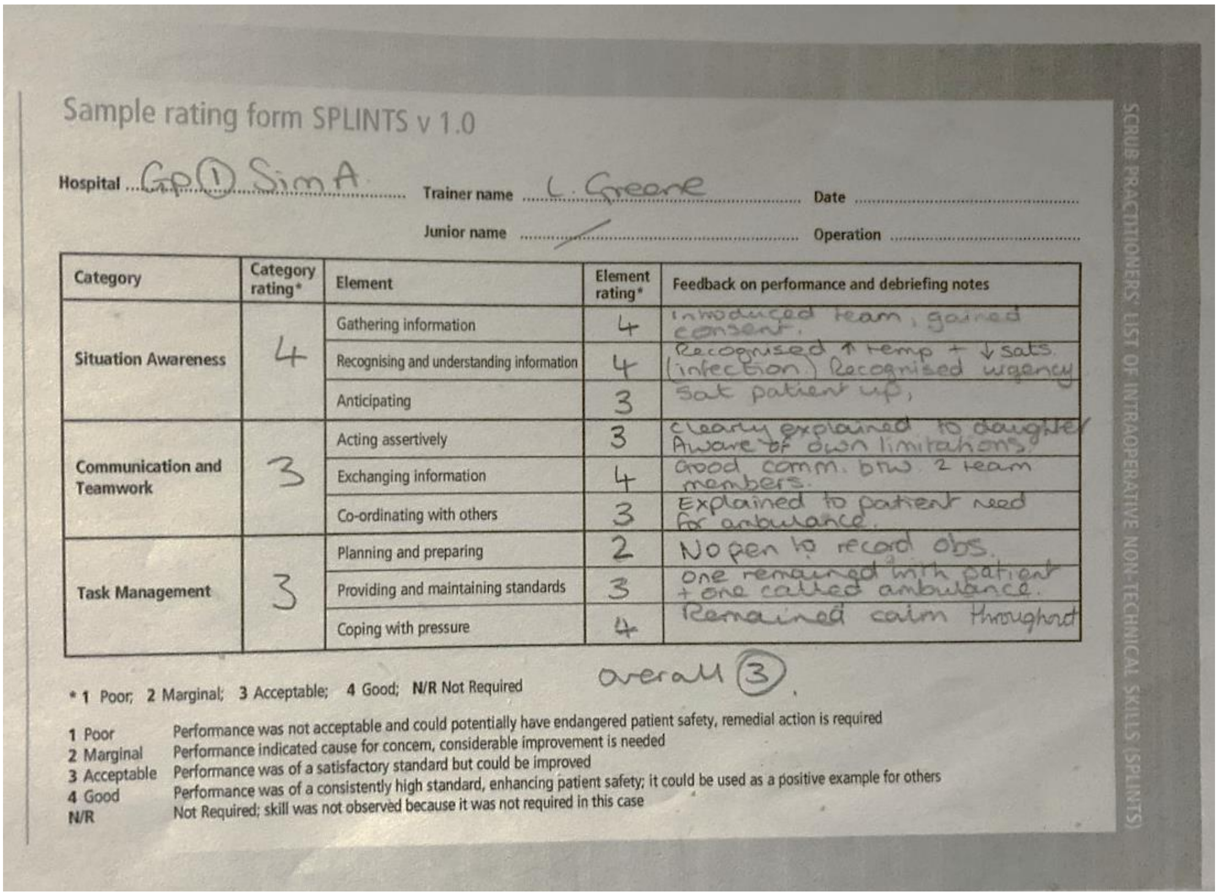


Figure 4-8: Pilot study - Intensity of participant's negative, low control emotions (pre and post simulation)

4.4.3.2 Pilot study RQ2. Evaluation of A/V recording, camera positions and sound quality

Following the pilot study, recorded videos were observed and analysed. The SPLINTS system (Mitchell et al., 2013) was used to record and rate participant's behaviours and non-technical skills (Figure 4-9).



Sample rating form SPLINTS v 1.0

Hospital Gp (1) Sim A Trainer name L. Greene Date

Junior name Operation

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situation Awareness	4	Gathering information	4	Introduced team, gained consent.
		Recognising and understanding information	4	Recognised ↑ temp + ↓ sats. (infection) Recognised urgency
		Anticipating	3	Sat patient up,
Communication and Teamwork	3	Acting assertively	3	Clearly explained to daughter Aware of own limitations.
		Exchanging information	4	Good comm. btw. 2 team members.
		Co-ordinating with others	3	Explained to patient need for ambulance.
Task Management	3	Planning and preparing	2	No pen to record obs.
		Providing and maintaining standards	3	One remained with patient + one called ambulance.
		Coping with pressure	4	Remained calm throughout

overall (3).

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/R Not Required

1 Poor Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal Performance indicated cause for concern, considerable improvement is needed
3 Acceptable Performance was of a satisfactory standard but could be improved
4 Good Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R Not Required; skill was not observed because it was not required in this case

SCRUB PRACTITIONERS' LIST OF INTRAOPERATIVE NON-TECHNICAL SKILLS (SPLINTS)

Figure 4-9: Pilot study - Example of SPLINTS system used for rating participant's behaviours

Audio/video recordings were considered appropriate for observations; sound and video quality were sufficient to enable interpretation. The SPLINTS system (Mitchell et al., 2013) revealed Category scores and Element scores for each group, as well as written feedback on performance. The researcher made notes on each group's ability to gather information, recognise and understand information, anticipation of events, their ability to act assertively, how they exchanged information and coordinated with each other. The final Category, concerning Task Management, included comments on the group's ability to plan and prepare, provide, and maintain standards and cope with pressure. Written feedback from the SPLINTS system included, for example, whether groups introduced themselves, if they recorded the patient's physiological observations, and what actions they undertook.

Whether the participants were prepared and calm, as well as their allocation of roles was also recorded, for example, '*one remained with the patient, one called an ambulance*' (Pilot study, Group 2).

4.4.3.3 Pilot study RQ3. Reflections on the scenarios and lessons learnt prior to main research study

Personal reflections on the pilot study (scenarios and lessons learnt) will be discussed below. An important finding from the pilot study was that the structured observation tool (SPLINTS system, Mitchell et al., 2013) did not yield data of great enough depth, which was contemplated and addressed in the main research study.

4.4.4 Personal reflection on the pilot study

*I again used Kolb's experiential learning cycle (1984) to provide a structured method for reflecting on and learning from, a **concrete experience**, in this case, the pilot study.*

***Reflections**: <u>What worked well</u>? Recording the scenarios and analysing them at a later date worked well, it enabled me to act as a researcher and not become overwhelmed by trying to carry out too many tasks. It also relieved the pressure during the pilot study, as I knew that the data was being recorded and retained. The cameras and sound quality proved sufficient. The quality was not high definition, but it was adequate for the purpose of this research; the participants, facilitators and patient's voices were all audible and I could see them, their movements, and actions clearly. This enabled the SPLINTS system to be completed successfully. The timings were also appropriate; the sessions did not overrun or experience any delays. All participants completed the scales and questionnaires with no issues, and, unlike the feasibility study, there was no missing data. The pilot testing of the knowledge and demographic questionnaires was successful. All three scenarios worked well, the participants met their learning objectives and there were no operational issues with the technology or simulated patient.*

<u>What didn't work well</u>? Having completed the SPLINTS system, it was apparent that the data was not detailed enough to enable a deep understanding of participant's behaviours and actions during simulation. The SPLINTS system was structured and elicited both quantitative and qualitative data, but the observations were drawn from my perspective, which could have contributed to observer bias; it was my interpretation of the participant's actions,

rather than what actually happened. I knew that I needed to adapt and use the data differently. Furthermore, the scenarios (Manikin, Human SP and Paper-case) were developed to incorporate a range of different simulation modalities of differing levels of realism from the spectrum of simulation. Again, this was my interpretation, not the viewpoint of the learners. Upon reviewing the GEW data, the presentation via bar graphs seemed inappropriate and combined (total) GEW data from all of the scenarios was presented, which did not allow for comparison or isolation of the emotions of participants from each of the scenarios.

Abstract conceptualisation: *it was important to incorporate the reflections and develop a plan prior to the main research study. An additional method for analysing participant's behaviours would also be required to yield data of greater depth, rather than an observer's interpretation of what happened. A realism scale would also be sought to appraise the participant's perceptions of the realism of the different scenarios, which would clarify the assumption that a paper-case or a procedural scenario with a manikin was not as realistic or immersive as a scenario with an embedded human simulated patient. An alternative method for presenting the GEW data would be required to enable comparison between scenarios, rather than combining data.*

Active experimentation: *Three actions were decided as a result of the reflections and lessons learnt from the pilot study: 1. Incorporate a validated realism scale into the main research study, 2. Carry out unstructured thematic analysis of video recorded scenario data to gain a deeper understanding of participant's behaviours and actions during simulation scenarios, 3. Present separate, rather than combined, GEW data for each scenario to allow comparison of participant's emotions pre- and post-scenarios.*

4.4.5 Pilot study conclusion

In conclusion, the pilot study was successful in piloting the demographic and knowledge questionnaires. Data has been successfully analysed. All participants had a high level of self-efficacy and were able to cope with the stressful scenarios that were presented to them during the pilot study. Combined GEW (Scherer, 2005; Scherer et al., 2013) scores were reported from the pilot study; this data was not isolated to distinguish between the different simulation scenarios. Data will be separated when reporting the GEW results for the main research study. Reflections concluded that alternative techniques for presenting the GEW data graphically would be required. Furthermore, in order to gain data of greater depth related to the participant's behaviours during simulation, additional qualitative observational methods, in the form of unstructured observation, data transcription and thematic analysis would be employed during the main research study. This would aim to generate richer data, utilising both deductive and inductive approaches to fully answer the overarching research question and to enable analysis of learner’s behaviours. Insight into the perceived realism of the different simulation scenarios was considered to be a valuable addition; to compare the participant’s perceived realism of the three scenarios, which would assist with exploring the study objectives. A scale to measure the realism in each of the three simulation scenarios would be integrated into the main research study, to record the perception of realism of the different simulation modalities, and its effect on learner’s engagement and emotional response.

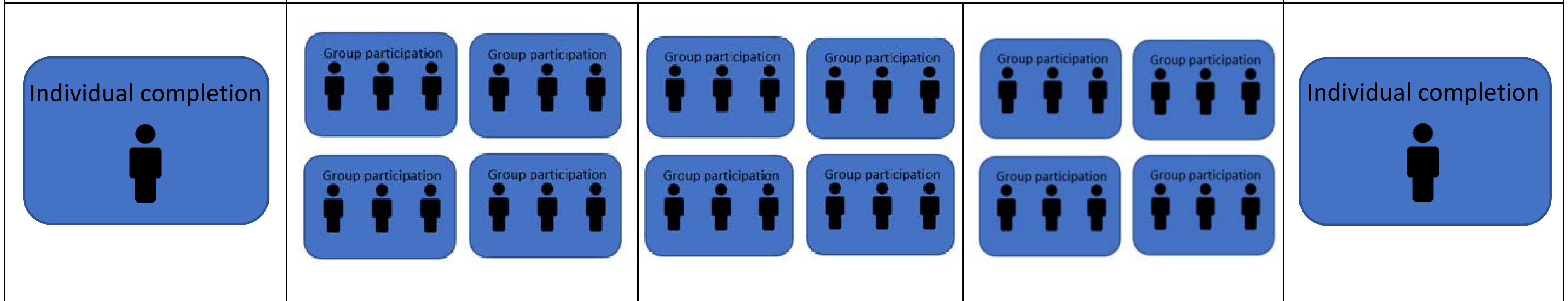
4.5 Main research study

The main research study took place in October 2017. Participants were invited to take part in the research study over three weeks during their scheduled teaching sessions. The following section will describe the research study design, data collection and data analysis methods, plus the recruitment process.

4.5.1 Research study design

A mixed methods approach was employed, using quantitative data to explore the research question and qualitative observational data to provide context and background. The methods included pre- and post-intervention measurement of participant’s knowledge and emotions via self-reported questionnaires, pre-intervention self-efficacy measurement, post-intervention realism assessment, plus analysis of behaviours using both structured and unstructured participant observation methods during the interventions. The method adopted was a concurrent embedded design, as discussed in Chapter 3, Section 3.5.1. Using this method, the qualitative component (participant observation) was embedded during three different interventions. The qualitative data were collected concurrent to the implementation of the interventions, with a focus on discovering how the participants experience the interventions (Bergman, 2008). The quantitative data was collected before and after the interventions. The research design is illustrated in Figure 4-10.

$T_{1,2,3}$	T_1 Scenario 1: simulation with a Manikin patient	T_2 Scenario 2: simulation with a Human simulated patient	T_3 Scenario 3: simulation using a Paper-case study	$T_{1,2,3}$
Pre-simulation		**During simulation**		**Post-simulation**



Pre-simulation	During simulation	Post-simulation
• General Self Efficacy Scale (GSES) • Knowledge Visual Analogue Scale (Pre-VAS) • Geneva Emotion Wheel (Pre-GEW)	• Audio-visual (AV) recorded • Structured participant observation using Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) system • Unstructured participant observation	• Knowledge (Post-VAS) • Post-GEW • German VR Simulation Realism Scale

Figure 4-10: Research process showing concurrent embedded design

4.5.2 Data collection tools

The following questionnaires, scales and systems were used to gather data, which was analysed after the data collection phase.

4.5.2.1 Questionnaires and scales:

- Knowledge questionnaire directly linked to the scenario learning outcomes with associated visual analogue scale (VAS) (Hayes and Patterson, 1921)
- General Self Efficacy Scale (GSES) (Schwarzer and Jerusalem, 1995)
- Geneva Emotion Wheel (GEW) (Scherer, 2005; Scherer et al., 2013)
- The German VR Simulation Realism Scale (Poeschl and Doering, 2013)

Structured observation system (for observation of behaviours)*:*

- Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) system (Mitchell et al., 2013)

Unstructured participant observation (for observation of behaviours):

- Transcription of audio/video, followed by thematic analysis (Braun and Clarke, 2006)

Knowledge visual analogue scale (VAS)

A knowledge questionnaire was developed with four statements directly linked to the learning objectives and outcomes, specific for each scenario. Construct validity is confirmation that the instrument is measuring the underlying concept it claims to measure (Bowling, 2004). It was not possible to measure and confirm construct validity of the Knowledge visual analogue scale (VAS) because the knowledge questions were specifically linked to the learning outcomes for each scenario. However, the design of the questions and the use of a VAS to measure knowledge was based on existing evidence; Josipovic et al. (2009) carried out a study to examine nursing and chiropractic undergraduate students' knowledge retention and self-rated ability to perform cardiopulmonary resuscitation (CPR) and Basic Life Support (BLS). In the study by Josipovic et al. (2009), a VAS was used for the students to score their self-rated perceived knowledge and skills regarding questions related to CPR/BLS. Morris (2018) explored the use of VAS in Occupational Therapy programmes to measure student's knowledge gain; they found that the use of a VAS linked to specific learning objectives in this context was a useful and viable option:

> ‘Visual analog (sic) scales, connected to course learning objectives and administered before and after course delivery, can be considered a viable option for instructors’ toolkit as a method for assessing students’ perception of knowledge’ (Morris, 2018: 1).

A mixed methods study by Kennedy et al. (2019) also used a pre- and post-module VAS with medical students to self-assess their learning needs linked to module learning outcomes. The VAS measured history taking skills, examination skills, knowledge of medication use, co-morbidity, and nutritional and swallowing assessment responses, before and after the module. Kennedy et al. (2019) discovered that students saw the VAS as useful tool to prompt awareness of their current and future learning needs. Furthermore, Chang et al. (2024) carried out a mixed methods study to explore the impact of an immersive virtual reality simulator education program on nursing students’ intravenous injection administration. They utilised a pre- and post-test VAS to assess student’s intravenous injection knowledge. Chang et al. (2024) also carried out paired t-tests to compare knowledge at pre-and post-tests, highlighting that this was an acceptable technique for assessing and analysing student learner’s knowledge.

Content validity refers to whether the scale covers all aspects of the characteristic or trait to be measured ‘in a balanced way’ (Bowling, 2004: 11). In a bid to achieve content validity of the scale developed for this current research, the Knowledge VAS was linked to each specific scenario learning objective, hence ensuring that the scale measured all aspects of the concept being analysed (Middleton, 2022). Face validity is ‘more superficial than content validity’ (Bowling, 2004: 11); it is a subjective assessment of whether items on the scale appear to be measuring the variables they claim to measure ‘on the face if it’ (Bowling, 2004: 11-12). Therefore, the Knowledge VAS can be considered to have face validity. Test-retest reliability was measured over time by piloting this scale with another group of learners prior to using it for the main research study. The knowledge questionnaire used to collect knowledge data for this study incorporated a visual analogue scale, which was a 10cm long line on which participants were asked to mark their agreement with the statement anywhere on the line from 0 on the left (least extreme, disagree) to 10 on the right (most extreme, agree) (Figure 4-11). There were four questions related to the scenario learning outcomes, learning was therefore, measured on a scale of minimum, 0 to maximum, 40.

Figure 4-11: Visual analogue scale used to measure participant's knowledge

General Self Efficacy Scale (GSES) (Schwarzer and Jerusalem, 1995)

The GSES is a valid scale for measuring self-efficacy (Schwarzer, 1993, Schwarzer and Jerusalem., 1995). The GSES yielded internal consistencies between alpha = .75 and .91. The scale is reliable and valid in terms of convergent and discriminant validity: 'it correlates positively with self-esteem and optimism, and negatively with anxiety, depression, and physical symptoms' (Schwarzer, 1999: online). In a study by Lazic et al. (2021) with 3667 undergraduate students from Serbia, the GSES was found to have adequate internal consistency, moderate test-retest reliability, and good convergent validity (Lazić et al., 2021). In a German study with 246 cardiac patients, the retest-reliability was r = .67 (Schröder et al., 1998), further evidence of GSES reliability is provided in another German study of 140 teachers, where a stability coefficient of r = .75 was found after one year and 2846 students, who filled out the scale twice, a retest reliability of r = .55 was discovered (Schwarzer and Jerusalem, 1999). The GSES was used in this current study to assess a general baseline sense of perceived self-efficacy with the aim of predicting whether learners were able to cope with daily difficulties, as well as how easily they could adapt after experiencing different kinds of stressful life events (Schwarzer and Jerusalem, 1995). Individual GSES scores are calculated by adding up the scores from all responses to provide a sum score. There are ten statements with scores ranging from 1 (Not at all true) to 4 (Exactly true). Therefore, GSES scores can range from minimum 10 to maximum 40 points. In order to calculate high or low self-efficacy median self-efficacy scores from the feasibility study (28) and pilot study (30) were utilised and a median GSES score of 29 was decided to distinguish between participants with low or high self-efficacy.

Geneva Emotion Wheel (GEW) (Scherer, 2005; Scherer et al., 2013)

The GEW is a reliable, theoretically derived, and empirically tested instrument that can be used to measure emotional reactions to objects, events, and situations (Swiss Center for Affective Sciences, 2023). A comparison study by Caicedo and van Beuzekom (2006) discovered that, on average, participants experienced a significantly greater ability to describe their feelings while using the GEW (M = 5,18, SE = 0.24) when compared with another similar tool, the Product Emotion Measuring Instrument (PrEmo) (Desmet, 2003) (M = 3,63, SE = 0.26, $t(40) = -4.44$, p (two-tailed) < 0.005, $r = 0.58$) (Caicedo and van Beuzekom, 2006). Caicedo and van Beuzekom (2006) also concluded that respondents also overall preferred the GEW over the PrEmo, and judged it clear to understand, useful to differentiate between emotions, and appealing in its visual design (Caicedo and van Beuzekom, 2006). The wheel itself consists of 'discrete emotion terms corresponding to emotion families that are systematically aligned in a circle' (Sacharin et al., 2012: 1). The GEW is used to measure, as precisely as possible, self-reported emotions experienced. The GEW is used to rate the intensity of emotions shown in the wheel. It is divided into four quadrants representing positive/high control, positive/low control, negative/low control, and negative/high control, as shown in Figure 4-12. The GEW is a useful instrument to measure emotions where repeated measurements are required (Tran, 2004). It has been used in many contexts including assessing the emotions of learners in virtual environments (Longhi et al. 2009; Santos, 2008) and measuring emotions during everyday life (Scherer et al., 2013).

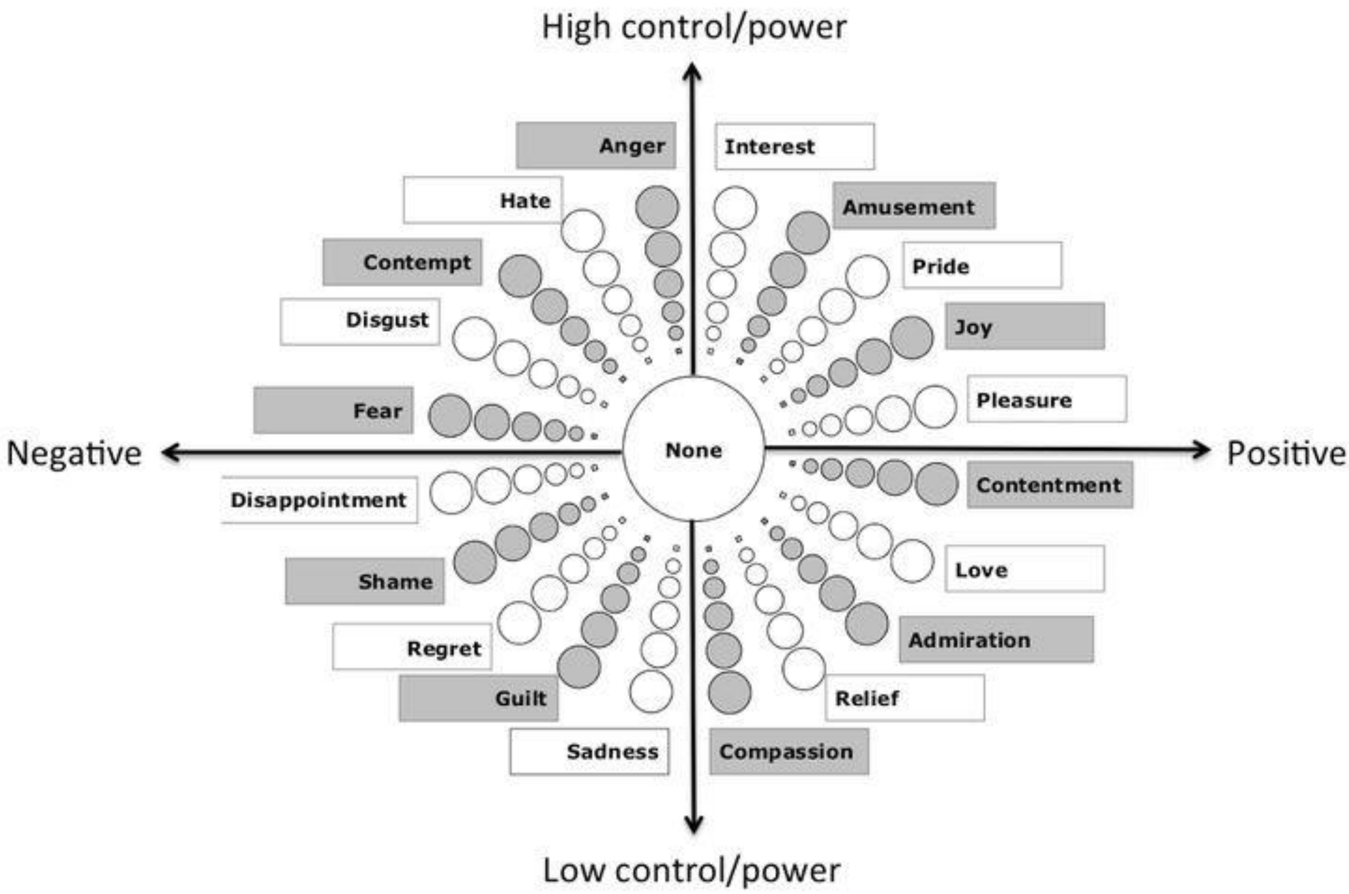


Figure 4-12: Geneva Emotion Wheel quadrants (Scherer, 2005; Scherer et al., 2013)

Participants were asked to determine the intensity of each of the emotions presented in the wheel and to tick the circle in the 'spike' (Scherer, 2005: 723) that corresponded to this emotion family. The bigger the circle, the stronger the emotion experienced. Scherer (2005) and Scherer et al. (2013) elaborate to state that different intensities can correspond to different members of an emotion family, for example, irritation can be considered a less intense emotion belonging to the Anger family, and anxiety can be considered a less intense emotion belonging to the Fear family (Scherer, 2005; Scherer, et al., 2013). Participants were asked to complete the GEW for all twenty emotion families in the wheel.

The German VR Simulation Realism Scale (Poeschl and Doering, 2013)

An adapted version of the German VR Simulation Realism Scale (Poeschl and Doering, 2013) was used to assess the realism of the three different scenarios. Poeschl and Doering (2013) claim that immersion produces a realistic experience for the user in VR applications. The

German VR Simulation Realism Scale is a 14-item self-reported scale, developed to measure one aspect of immersion, namely simulation realism (Poeschl and Doering, 2013); it measures four factors: Scene Realism, Audience Behaviour, Audience Appearance and Sound Realism. The German VR Simulation Realism Scale has ‘sufficient reliability’ (α>80) (Poeschl and Doering, 2013:35). A recent revalidation of the scale with a Polish sample found it was a well-established tool that can be used for subjective measurement of simulation realism (Lipp et al., 2021). The revalidation found that the reliability of the scale is ‘satisfying’ (Lipp et al. 2021: 27).

The original German VR Realism Scale was developed based on a translation of scene realism items from the Witmer-Singer-Presence Questionnaire (1998). Presence is linked to realism; Witmer and Singer (1998) described presence as how well a participant is involved or immersed in virtual simulation. MacLean et al. (2019) conducted mixed methods research into nursing student’s perception of realism and presence in simulation. They concluded that ‘Future simulation studies should modify terminology and items used in VR presence scales to accommodate non-VR modalities and avoid potential variability in simulation research’ (MacLean et al., 2019: 331). This provides justification for adapting the original German VR Realism Scale for the purpose of this current study. Dang et al. (2018) also assessed nursing student’s perception of presence in different modalities including simulation, VR, and television during clinical training. They, too, advocate the adaption of scales to assess presence, confirming that ‘A sim-modified presence scale can evaluate and inform designs of future sim environments’ (Dang et al., 2018: 36). Therefore, the original German VR Simulation Realism Scale was adapted for the purposes of this research study to make it applicable for simulation-based education, rather than virtual reality applications. Two items were removed: ‘Colouring in the CAVE appeared to be natural’ and ‘Virtual humans differed concerning their appearance’ (Poeschl and Doering, 2013: 36), the term ‘virtual humans’ (Poeschl and Doering, 2013: 36) was replaced with ‘simulated patients’ and the term ‘virtual space’ (Poeschl and Doering, 2013: 36) was replaced with ‘simulation environment’. The adapted 12-item scale, along with the other data collection tools, can be found in Appendix E. The scale measuring simulation realism is scored using a five-point scale from 1 (strongly disagree) to 5 (strongly agree). Total simulation realism, therefore, can range from 12 (low simulation realism) to 60 (high simulation realism).

Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) System (Mitchell et al., 2013)

The SPLINTS system (Mitchell et al., 2013) is a structured behavioural rating system used to assess social and cognitive -technical skills. SPLINTS is one of many non-technical skills (NTS) systems that has been developed from a NTS taxonomy developed by The Applied Psychology and Human Factors Group at the University of Aberdeen. They define NTS as:

> '…the social (teamwork, leadership, communication), cognitive (situation awareness, decision-making, cognitive readiness, task management) and personal management (stress and fatigue management) skills necessary for safe and effective performance' (The Applied Psychology and Human Factors Group, 2023).

The NTS taxonomy has been adapted so it is applicable to alternative settings including nuclear power, aviation, healthcare, and agriculture. The Applied Psychology and Human Factors Group developed the Anaesthetist Non-Technical Skills System (ANTS) (Fletcher et al., 2004), Surgeons' non-technical skills (NOTSS) (Yule et al., 2006) and the SPLINTS system (Mitchell et al., 2013), which has been adapted to evaluate the non-technical skills utilised by farmers (Farmer LIst of Non-Technical Skills, FLINTS) (Irwin and Poots, 2015). There is no specific NTS system directly linked to Physiotherapists, however, a NTS taxonomy developed for other healthcare professionals, for example scrub nurses and operating department practitioners (ODPs) can be appropriately applied to other healthcare professional groups.

The SPLINTS system is deemed a reliable, usable, and accurate system for assessing non-technical skills in simulated, standardised, video-based scenarios (Mitchell et al., 2012). Reliability was measured by Mitchell et al. (2012) via a reliability within-group agreement (r_{wg}) for the three skill categories. Six out of nine elements were deemed acceptable ($r_{wg} > 0.7$). Participants were within 'one scale point of expert ratings in >90% of skill categories and elements' (Mitchell et al., 2012: 201). SPLINTS can be used to score performance with a 'reasonable level of accuracy' (Mitchell et al., 2012: 208). The SPLINTS system has good internal consistency (absolute mean difference was $M < 0.2$ of a scale point) for all three categories. The system is 'complete and usable' as an assessment tool (Mitchell et al., 2012: 208). It is scored using a four-point rating scale: 1 (poor), 2 (marginal), 3 (acceptable) or 4 (good). Rating of N/R means those behaviours were not required. The SPLINTS system is separated into three main categories at the highest level, with nine elements underlying the skill categories (Flin et al., 2010a). The three main categories are Situation Awareness, Communication and Teamwork, and Task Management. Situation Awareness category has three Elements: Gathering information, Recognising and understanding information, and Anticipating. Communication and Teamwork has three Elements: Acting assertively, Exchanging information, and Co-ordinating with others. Finally, the three Elements associated with Task Management are: Planning and preparing, Providing and maintaining standards, and Coping with pressure. All the skill Elements (n=9) and Categories (n=3) are scored using the same four-point rating scale. Therefore, the SPLINTS system is measured on a scale for Categories, minimum 3 (poor) to maximum 12 (good) and for Elements, minimum 9 (poor) to maximum 36 (good).

4.5.3 Techniques of data analysis

Knowledge and emotion data were collected both pre- and post-engagement with simulation scenarios, thus enabling comparison of knowledge and emotion data from learners before and after each scenario. Self-efficacy data was collected pre-simulation to obtain an overall self-efficacy score. Realism data was collected post-simulation to gain the learners' rating of perceived realism following each scenario. Scenarios were audio/video (A/V)-recorded and the SPLINTS system (Mitchell et al., 2013) was utilised for structured observation to analyse learner's actions and behaviours during the three different simulation scenarios. Following the structured observation, learner's behaviours and spoken words were observed again via the recorded video, data was transcribed verbatim, and actions, for example, changing position in the room or passing a team-member a piece of equipment, were also noted. Transcripts were then thematically analysed to generate common themes, and subthemes, which were aligned to Bandura's (1977a) Social Learning Theory.

4.5.4 Triangulation

Triangulation was used to ensure that the data obtained was credible, rich, robust, comprehensive, and well-developed (Lincoln and Guba, 1985). Triangulation methods used in this research study were data triangulation (Denzin, 1978; Patton, 1999); where different methods to collection data were used, and triangulation of sources (Denzin, 1978; Patton, 1999); where data was examined at different points in time and in different settings. Multiple methods and settings were used to develop a deeper understanding of the phenomena under investigation.

Miller's (1990) framework states that there are four levels at which a learner should be assessed:
a) Knows (knowledge) – recall of facts, principles, and theories
b) Knows how (competence) – ability to solve problems and describe procedures
c) Shows how (performance) – demonstration of skills in a controlled setting
d) Does (action) – behaviour in real practice

Different modalities of simulation were being used to examine the levels of learning (Issenberg et al., 2005) applicable to Miller's (1990) framework. The Paper-case was used to evaluate participant's knowledge and competence (a and b), while the physical scenarios involving a Manikin and Human SP were used to analyse participant's knowledge, competence, and performance (a, b, and c above). As the scenarios were all simulated, Level d, behaviour in real practice, was not addressed even though learners were in action during the scenarios.

4.5.5 Recruitment

Participants were recruited to the main research study via a video invitation, which was posted on the University's virtual learning environment (VLE), Moodle, one week prior to timetabled simulation sessions. To access the Invitation to Participate video, please click the following link:
https://mmutube.mmu.ac.uk/media/LGreene_Invitation+to+participate/1_nef88jrj. A purposive sample of students from the Pre-registration (Pre-reg) Masters (MSc) in Physiotherapy programme were approached to participate as they had never experienced simulation before. These students were unknown to the researcher and had not been taught by her previously. They took part in the study on three separate occasions over a three-week period. Participation was voluntary and scheduled during the learner's timetabled simulation-based education activities to minimise disruption, except for the Paper-case, which was scheduled during a lunch break and participants were invited to

attend. The Pre-reg MSc in Physiotherapy was a small cohort and all eleven students consented to their involvement. Nobody withdrew from any part of the research study. The eleven participants were split into four subgroups for each scenario of two or three learners to keep the number of people entering the scenarios realistic and manageable. The participants all engaged in three different scenarios over three weeks (these will be referred to as the Manikin scenario, the Human SP scenario, and the Paper-case). The subgroups were randomly assigned each week, so participants did not work with the same subgroup or friendship group on any week. The participant information sheet and consent form can be found in Appendix F and G. Demographics and descriptive data are presented in Chapter 5 and qualitative findings are presented in Chapter 6. Findings will then be discussed, and conclusions drawn in Chapter 7.

As participants involved in the research study were all student learners participating in simulation-based education as part of their Academic programme of study, they will be referred to as Learners from this point. Learners engaged with three different scenarios, the Manikin scenario, the Human SP scenario and Paper-case and their knowledge, self-efficacy, emotions, experiences, and behaviours were analysed.

4.5.6 Preparation for simulation scenarios

Prior to participation in the scenarios, learners had experienced theoretical and practical skills-based teaching and learning related to the scenarios to prepare them for simulation. However, the learners had never been involved in any immersive, or procedural simulation-based education prior to the Manikin scenario. As a result, all learners experienced a full induction and orientation to the manikin and simulated environment prior to physical participation. Learners were also introduced to the patient they would be caring for one week prior to the first scenario via a short video vignette. This gave the learners insight into the patient's likes, dislikes, mobility, living arrangements and social context. The overall goals and learning outcomes for each of the scenarios are described below.

4.6 Description of the scenarios

Scenarios involving different simulation modalities were investigated and learner's knowledge, self-efficacy, emotions, and behaviours were analysed. The scenarios all involved the same simulated patient, Mr Levi Williams[11], whom the learners met and cared for at different stages over a three-week period. The physical scenarios were embedded into an Academic Unit of study at the University where the research took place. The Paper-case was created specifically for the purpose of this research study. Scenarios were designed using the North West Simulation Education Network (NWSEN) scenario design simulation proforma (Figure 1-4); full documentation for each scenario can be found in Appendices I, J and K.

4.6.1 Who is Levi Williams?

Information about Mr William's personal elements of the simulated patient role were consistent throughout all three scenarios, only the context in which the learners found Levi changed. Mr Levi Williams was a 61-year-old man, who lived with his wife, Alana, and Sadie, their border collie. He was a father of two children: Ben aged 23, an architect and Hollie, 30, a primary school teacher. Both of their children left the family home after they returned from studying at university. Levi was lively, active and had a very caring nature. He was passionate about dogs and animals in general. Levi and his wife enjoyed walking Sadie the dog together, although Levi needed to use his elbow crutches, a stick or wheelchair more often, which was affecting his mood as he longed to be more active. Levi had a diagnosis of Multiple Sclerosis (MS) and a recurrent urinary tract infection (UTI). A three-minute video vignette introducing the patient in his home environment was created to firmly embed Levi at the heart of each of the scenarios. This video vignette depicted Levi at home, watching television and listening to the radio. He is seen walking around his home, using elbow crutches, washing the dishes, and talking on the telephone to his son, Ben. Levi can be heard talking to his wife, Alana and their dog, Sadie, can be heard whining in the background. Figure 4-13 illustrates some still images taken from the video vignette. From this short video vignette, learners gleaned insight into Levi's personality, his preferred music and television choices, his lifestyle, and his support network at home. They also gathered data on his usual mobility, gait, speed of movement and use of crutches. Levi's simulated patient role profile documentation can be found in Appendix H.

[11] Mr Levi Williams is a pseudonym created for the purposes of simulation. The simulated patient role profile and associated scenarios were entirely made up and did not relate to an actual person or situation.

Levi watching television

Levi moving using elbow crutches

Levi washing the dishes

Levi talking on the telephone to his son, Ben

Figure 4-13: Still images taken from Levi's three-minute introduction video vignette

4.6.2 Manikin scenario

The overall goal for the Manikin scenario was to *develop, justify and apply management strategies for specific patients in real-time in simulated situations*.

There were six learning objectives:

1. Carry out a subjective and objective community respiratory physiotherapy assessment
2. Identify normal and abnormal values for vital signs in adults, using track and trigger patient scoring systems to identify a deteriorating patient, for example, a Patient At Risk Score (PARS), Modified Early Warning Score (MEWS) or National Early Warning Score (NEWS)

3. Contribute to the management of the acutely deteriorating adult patient
4. Work as a team to communicate with the patient and his family member
5. Carry out a range of possible physiotherapy interventions to manage a deteriorating adult patient when the cause is of a respiratory origin
6. Consider the impact of co-existing diseases such as multiple sclerosis (MS) on the physiotherapy management of a respiratory patient

The Manikin scenario was presented in a simulated home environment set-up in a Simulation Laboratory on the fourth floor of an academic University building in the Faculty of Health and Education. The high-tech manikin patient was positioned supine in bed with two pillows, dressed in casual clothes and with a catheter in situ. The Manikin used was a Laerdal SimMan Essential (Laerdal Medical, 2023), which was controlled from a separate room via a laptop computer/tablet. The high-tech manikin had breath sounds, heart sounds, pulses, respiration rate, reactive pupils, and blinking eyes. The manikin was wearing a grey wig and was voiced by a human simulated patient via a microphone positioned in a sound-proof control room. In addition to the bed, there were other equipment and props present in the room, these included two arm chairs, a television, a simulated fish tank, a large plant, a small set of drawers, a radio playing music loudly, a table, a kettle, three cups, a cupboard (to hide the medical totem unit housing oxygen, suction and nurse call system), a washing airer with washing hanging including blue pyjamas and a towel, a rug, a simulated window scene (to hide a large whiteboard), curtains and a curtain pole. In addition, there was a sink and a large, mirrored-glass window. An image of the Manikin scenario set-up can be found in Figure 4-14.

Figure 4-14: Image of the Manikin scenario set-up, taken from video recording

An embedded facilitator was present in the room with the learners taking part in role as Levi's daughter, Hollie. A Technician and a simulated patient were present in an adjoining Control Room. The Control Room had one-way mirrored glass, so the Technician and simulated patient could see into the Simulation Laboratory, but the learners could not see into the Control Room. The Technician's role was to operate the manikin and change the patient parameters according to the actions of the learners and answer the telephone during the scenario. The simulated patient voiced the manikin via a push-to-talk microphone. A manikin was used in this scenario as the patient was unwell and deteriorating, it was, therefore, considered too dangerous to embed a human SP.

Full scenario documentation can be found in Appendix I. However, a brief summary of the scenario is as follows:

Manikin scenario summary

Mr Levi Williams has been referred to the community physiotherapy service by his GP. The GP referral letter explains that Mr Williams has Multiple Sclerosis (MS), and a recurrent urinary tract infection (UTI) and recent possible aspiration. He has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension. Recommendation for moving and handling included hoisting from bed to chair or wheelchair, assisted drinking and to cough post-swallow.

When you arrive at the patient's home you find Mr Williams lay in bed propped on two pillows. Levi's daughter, Hollie, takes the opportunity to nip to the chemist to collect her dad's prescribed medications. Before she leaves, she reports that Levi is currently very tired, has a weak cough and has been sleepy since yesterday. She mentions that Levi became quite chesty 2 days ago, when he had a drink of tea and thickened soup. Levi's wife, Alana, called the GP yesterday, but he has not improved overnight.

Prior to participation in the Manikin scenario, all learners completed the pre-simulation research questionnaires. They then re-watched the 3-minute video vignette introducing the patient, Levi Williams, on a large screen in a classroom to refresh their memory of who they were going to visit. Following this, learners were instructed to visit Levi at his home, assess him and make decisions about his care. They entered the Simulation Laboratory in small groups of two or three and the scenario lasted 20-minutes. The scenario was, therefore, repeated four times to enable the different groups of learners to participate. Learners were provided with a kitbag to take into the Simulation Laboratory with them. The kitbag contained the following equipment: a blood pressure monitor, a pulse oximeter, a box of medium sized disposable gloves, a roll of disposable aprons, a stethoscope, a tympanic thermometer, clipboard with patient notes, a pen, and a slide sheet. Learners were informed that the Facilitator would confirm when the scenario had ended at the end of 20-minutes.

Immediately following participation in the Manikin scenario, learners completed post-simulation research questionnaires. After all four groups had participated in the Manikin scenario, learners entered into a whole-group Facilitator-led debrief in a classroom, where they discussed and reflected on their actions in the scenario. Debrief questions can also be found in Appendix I. The post-simulation debrief and reflections that occurred during this time were not part of this research study and are therefore not reported in this thesis.

4.6.3 Human SP scenario

One week later the learners returned for the next scenario. The overall goal for the Human SP scenario was to *apply unit content to develop and justify the management and rehabilitation of patients with critical illness*.

There were six learning objectives:

1. Carry out a subjective and objective respiratory physiotherapy assessment
2. Identify normal and abnormal values for vital signs in adults, using track and trigger patient scoring systems to identify a deteriorating patient for example a Patient At Risk Score (PARS), Modified Early Warning Score (MEWS) or National Early Warning Score (NEWS)
3. Contribute to the management and rehabilitation of an adult patient recovering from acute deterioration and mechanical ventilation
4. Work as a team to communicate with the patient
5. Carry out a range of possible physiotherapy interventions to manage and rehabilitate an adult patient recovering from deterioration when the cause is of a respiratory origin
6. Consider the impact of co-existing diseases such as multiple sclerosis (MS) on the physiotherapy management of a respiratory patient

The Human SP scenario was presented in a simulated hospital environment set-up in a Simulation Laboratory on the fourth floor of an academic University building in the Faculty of Health and Education. The human simulated patient was positioned sat up in a hospital bed with two pillows. He was wearing the same grey wig that the manikin had worn and was dressed in casual clothes with a simulated catheter leg-bag in situ. In addition to the bed, there were other equipment and props present in the room, these included an armchair, a bedside cabinet, a patient monitor displaying the patient's saturations of oxygen, pulse, blood pressure and body temperature, an over-bed table, a plastic jug and water glass, a medical totem unit housing oxygen, suction and nurse call system, a large whiteboard, a nurse's desk and chair, a sink and a large, mirrored-glass window. An image of the Human SP scenario set-up can be found in Figure 4-15.

Figure 4-15: Image of the Human SP scenario set-up, taken from video recording

An embedded facilitator was present in the room with the learners taking part in role as a Staff Nurse. A Technician was present in an adjoining Control Room. The Technician's role was to operate the patient monitor and change the patient parameters according to the actions of the learners and answer the telephone during the scenario. The human SP was present in the Simulation Laboratory with the learners.

The full scenario documentation can be found in Appendix J. A brief summary of the scenario is as follows:

Human SP scenario summary

Levi Williams was admitted to the hospital 25 days ago. During this time, he was admitted to critical care for 8 days following admission from home. Levi was diagnosed with sepsis secondary to pneumonia and required mechanical ventilation for 3 days. His admission diagnosis was Multiple Sclerosis, and a recurrent urinary tract infection (UTI). The previous physiotherapy assessment findings indicate that he has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension. Recommendation for moving and handling included hoisting from bed to chair or wheelchair, assisted drinking and to cough post-swallow.

The Staff Nurse in charge reports that the Mr Williams slept well; she has requested a re-assessment, stating that he is ready for physiotherapy and interventions today.

Prior to entering the Human SP scenario, learners all completed pre- simulation research questionnaires. They were told 25 days had passed since they last saw Mr Williams, and were instructed to visit Levi in hospital, assess him and make decisions on his care and discharge. Then entered the Simulation Laboratory in small groups of two or three, the scenario was therefore repeated four times to enable all the learners to participate. The scenario lasted 20-minutes and learners were told that they would be informed by the Facilitator when the scenario had finished. Learners were provided with the kit and equipment they required in the Simulation Laboratory. This included: a blood pressure monitor, a pulse oximeter, disposable gloves, disposable aprons, a stethoscope, a tympanic thermometer, a slide sheet, various oxygen masks, clipboard with patient notes, a pen, and a hoist.

Immediately following participation in the Human SP scenario, learners completed post-simulation research questionnaires. After all four groups had participated in the Human SP scenario, learners entered into a whole-group Facilitator-led debrief in a classroom, where they discussed and reflected on their actions in the scenario. Debrief questions can be found in the scenario documentation in Appendix J. The post-simulation debrief and reflections that occurred during this time were again not included as part of this research study.

4.6.4 Paper-case

On the third week, learners attended a dedicated session to complete the Paper-case. The overall goal for the Paper-case was to *develop, justify and apply management strategies for specific patients in real-time in simulated situations.*

The paper case was developed to align with five specific academic unit of study learning outcomes:

1. Systematically and critically evaluate relevant literature underpinning evidence-based practice
2. Synthesise and analyse research findings in order to make value judgements about their contribution to the clinical evidence base
3. Develop reasoned arguments in order to evaluate clinical decisions
4. Engage effectively in debate, arguing and evaluating a variety of viewpoints in a professional manner to produce detailed and coherent arguments
5. Critically examine and reflect on their own practice and their own implementation of best available evidence and develop an understanding of some of the problems of implementing research findings into clinical practice

The Paper-case was presented in private rooms on the fourth floor of an academic University building in the Faculty of Health and Education where the learners could work uninterrupted. A table, chairs and pens were provided. An image of the Paper-case set-up can be found in Figure 4-16.

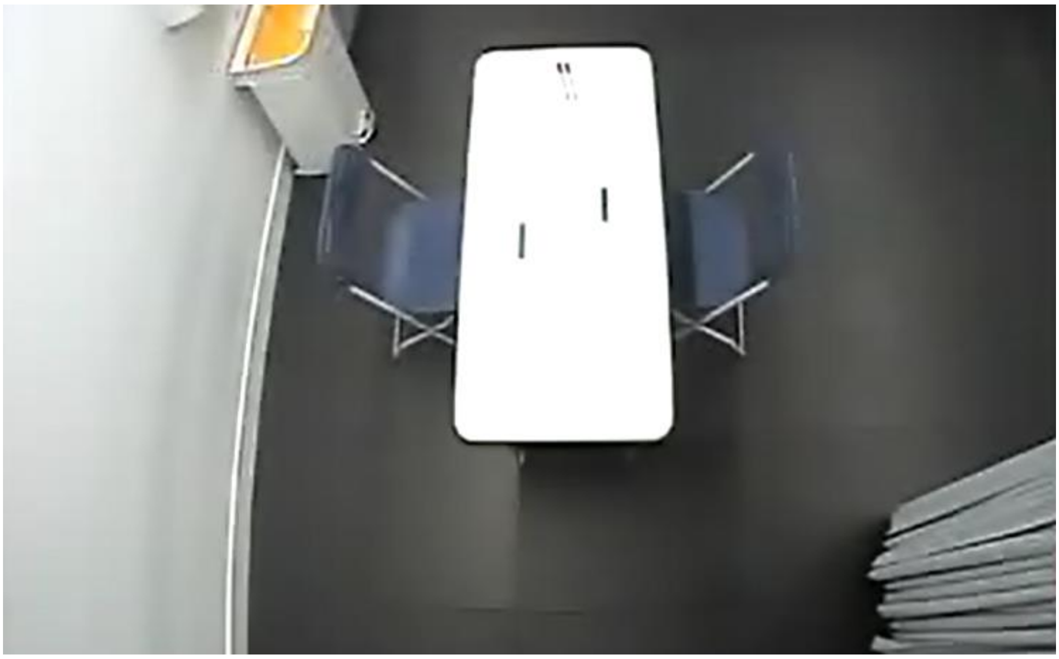


Figure 4-16: Image of the Paper-case set-up, taken from video recording

There was no embedded facilitator in the room, and learners were expected to work through the Paper-case together in small groups of three or four. The full Paper-case documentation can be found in Appendix K. A brief summary of the scenario is as follows:

Paper-case summary

Levi Williams has been referred to the community physiotherapy service following discharge from critical care. The referral letter explains that Mr Williams has Multiple Sclerosis (MS), and a history of recurrent urinary tract infections (UTIs) and recent aspiration resulting in ventilation and 29 days in hospital. He has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension. Upon discharge, the Physiotherapist recommended moving and handling with assistance of 1 from bed to chair or wheelchair. He is currently sleeping in the living room and has a commode.

When you arrive at the patient's home you find Mr Williams sat in the living room. Levi's wife, Alana, answers the door and informs you that she is worried about his mobility and low mood. Before leaving to walk Sadie the dog, she reports that Levi is more tired than usual; he still cannot use the stairs, although he is constantly asking to try on his own so he can sleep in the bedroom upstairs and have a bath.

Upon arrival, learners were randomly assigned to four separate rooms where they all completed pre-simulation research questionnaires. Following this, the researcher presented the learners with the Paper-case, and they were verbally informed that they had twenty minutes to complete it. All four groups completed the Paper-case concurrently in four separate rooms.

Written instruction stated that there were three parts to the scenario, and that learners had 20-minutes in total to complete their assessment and decision-making. For each part of the scenario, they were instructed to consider the events and prompts provided on the Paper-case. They were asked to write down in the table provided any actions that they would undertake from the perspective of the Community Physiotherapist responding to the referral in the patient's home. Learners were also informed that they had a bag containing the following equipment with them when they arrived at Mr William's home: blood pressure monitor, pulse oximeter, gloves, aprons, stethoscope, thermometer, and a slide sheet.

Immediately following participation in the Paper-case, learners completed post-simulation research questionnaires as part of the research study. After this, learners were free to leave; there was no whole-group facilitator-led debrief, discussion or reflection associated with the Paper-case.

4.7 Chapter summary

This chapter has described the methods undertaken to carry out the feasibility study and pilot study, along with their findings. It also included the reflections that helped shape and influence the process undertaken to design and implement the main research study. The next two Chapters present the findings from the quantitative arm (Chapter 5) and qualitative arm (Chapter 6) of the main research study.

CHAPTER 5 - FINDINGS FROM THE QUANTITATIVE STRAND OF THE STUDY

5.0 Chapter overview

The main research question was to explore the effect of realism on student learner's engagement and emotional response during simulation-based education. This Chapter aims to explore four Study objectives; a) To discover whether there a difference in realism between three simulation modalities, b) To explore whether realism effects learner's knowledge, c) To gain a baseline measure of learner's self-efficacy to explore the effect of self-efficacy on undergraduate student's ability to cope with the challenge of different simulation-based education scenarios and d) To gather data on the intensity of learner's emotions before and after engaging with different simulation-based education scenarios. This Chapter will present the demographic data and quantitative results from the main research study. It will explore and compare the perceived realism of each of the three scenarios (Manikin, Human Simulated Patient (SP) and Paper-case), plus knowledge, self-efficacy and emotion data discovered from three scenarios utilising different modalities of simulation. This Chapter will also describe the quantitative behavioural data obtained from structured observation (SPLINTS system). To address Study objective e) To observe learner's behaviour during simulation-based education, the SPLINTS data will be analysed, however, the qualitative data and extracted themes will be explored in greater depth in Chapter 6.

5.1 Learner's demographic data

Participants were student learners (n=11) from the Pre-registration Masters in Physiotherapy programme. Demographic data is shown in Table 5-1. The majority of participants were female (n=9, 82%). Ages ranged from 21-50 years, with the majority (n=7, 64%) aged 21-30 years. Most participants (n=7, 64%) held a Batchelors degree and 73% (n=8) were full-time students. In 2020 the Office for Students (OfS) reported that in England 90% of students studying nursing and 75% of allied health programme students were female (OfS, 2020). The Higher Education Statistics Agency (HESA) also reported in 2017/18, when the data collection for this study occurred, that the majority of students (80%) were aged between 20-29 (HESA, 2021). Therefore, it can be concluded that the demographics of the participants in this study were representative of the student population enrolled on health-related programmes in the Faculty of Health and Education at Manchester Metropolitan University and, indeed, Higher Education Institutions (HEIs) in the UK.

Table 5-1: Main research study learner's demographic data

Sex	Female (n=9, 82%) Male (n=2, 18%)
Age (years)	21-30 (n=7, 64%) 31-40 (n=3, 27%) 41-50 (n=1, 9%)
Academic qualifications	BSc (n=7, 64%), MSc (n=3, 27%) PhD (n=1, 9%)
Occupation	Public sector (n=2, 18%) Full time student (n=8, 73%) Part-time student (n=1, 9%)

5.2 Realism of scenarios

Using the adapted German VR Simulation Realism scale (Poeschl and Doering, 2013), the maximum possible realism score is 60, and the minimum score is 12. The Human SP scenario was perceived to be the most realistic scenario (score = 51), followed by the Manikin scenario (score = 42) and the Paper-case (score = 26), shown in Figure 5-1. The scenario with a Human SP was significantly more realistic than the scenario featuring a Manikin and the Paper-case ($p<0.001$) (see Table 5-2).

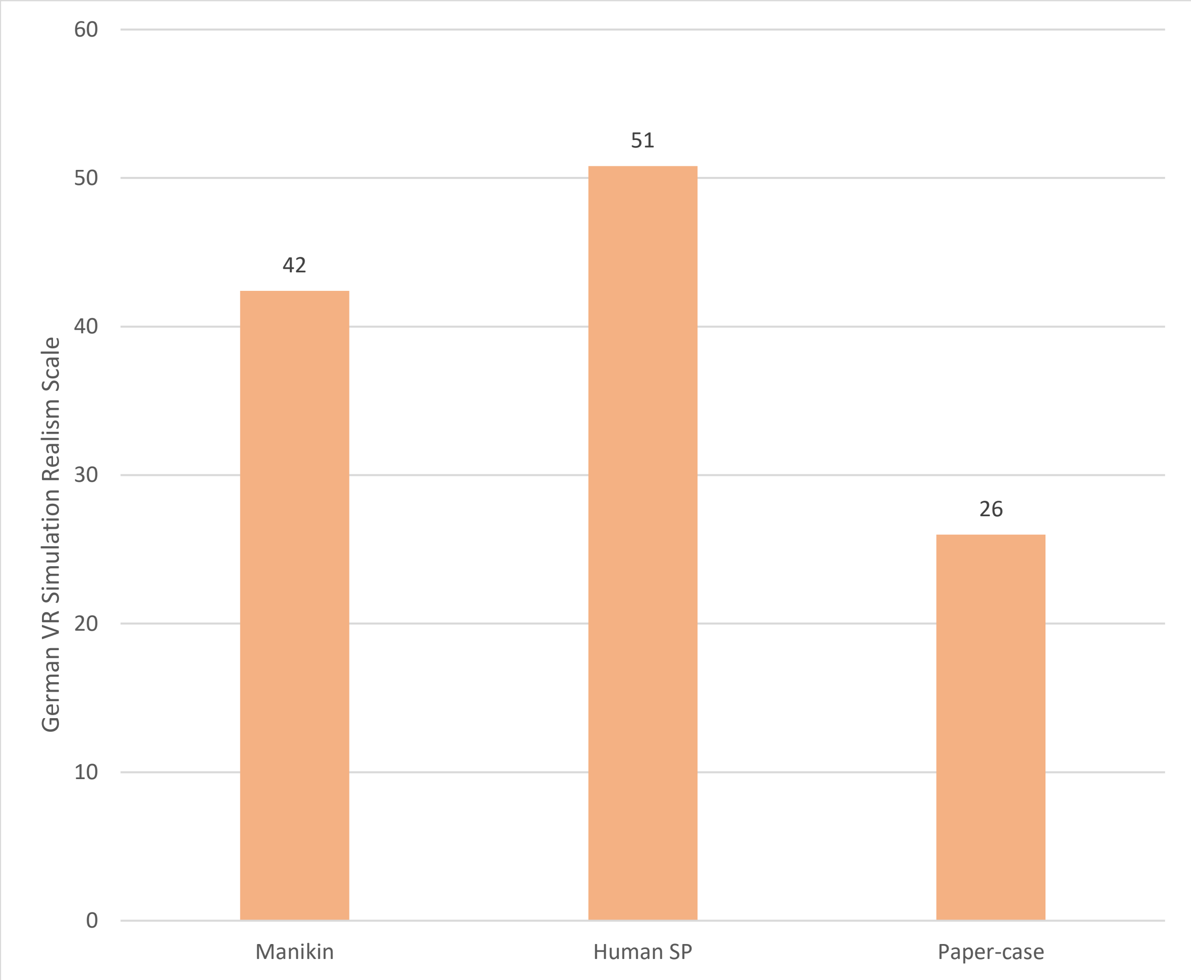


Figure 5-1: Perception of realism

Table 5-2: Realism score ANOVA

Groups	*Count*	*Sum*	*Average*	*Standard deviation (SD)*
Manikin	10	424	42.4	61.82
Human SP	11	559	50.82	55.56
Paper-case	11	286	26	111.6

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3497.18	2	1748.59	22.76	**<0.001**	3.33
Within Groups	2228.04	29	76.83			
Total	5725.22	31				

Objective a) To identify any differences in realism between three simulation modalities

In summary there is a difference in realism between the simulation modalities included in this study – the Human SP scenario was significantly more realistic than the other two modalities.

5.3 Learner's knowledge before and after scenarios

Knowledge was measured before and immediately after each scenario using a visual analogue scale (VAS), discussed in Chapter 4, linked to each of the simulation scenario learning outcomes. Figure 5-2 shows pre- and post-scenario knowledge scores for each scenario. There was no difference in pre-scenario knowledge scores between modalities (p=0.07, see Table 5-3). However, the difference in post-scenario knowledge scores between modalities was statistically significant (p=0.01, see Table 5-4). Post-knowledge scores were significantly higher following the Human SP scenario (26/40) and Paper-case (29/40). Knowledge scores decreased following the scenario with a Manikin (21/40-19/40), however, this difference was not significant (p=0.6, see Table 5-5). There was a statistically significant increase in pre/post knowledge following the scenario featuring a Human SP (22/40-26/40, p=0.01, see Table 5-5). Although knowledge increased post Paper-case (28/40-29/40), this difference was not statistically significant (p=0.1, see Table 5-5).

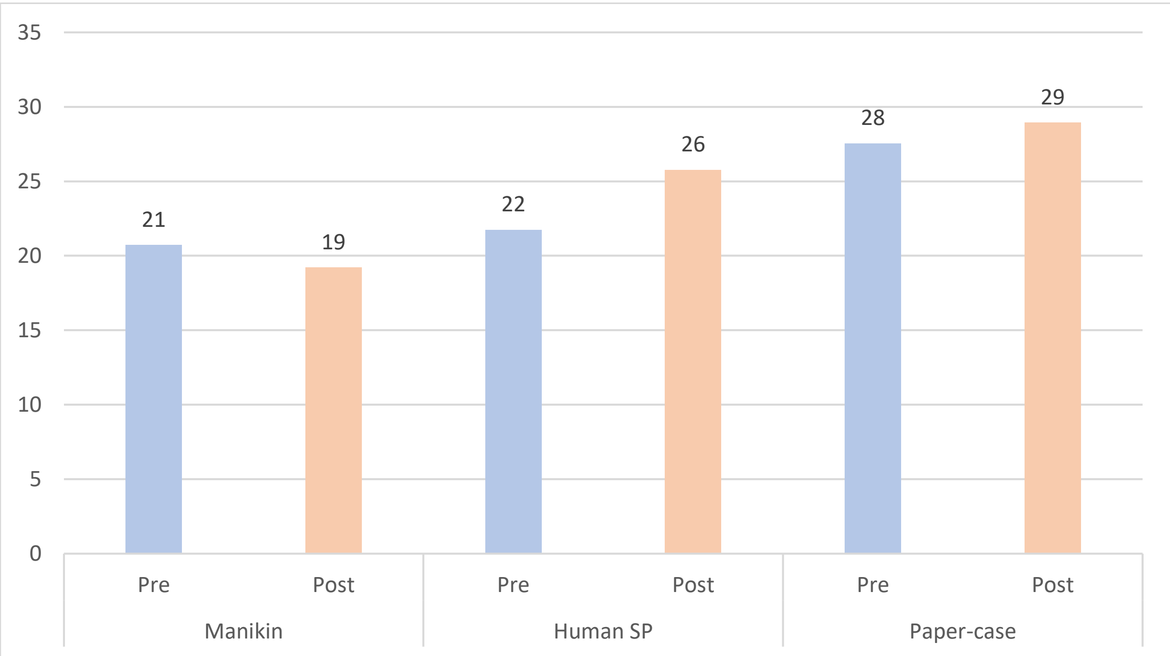


Figure 5-2: Knowledge scores (pre and post scenario)

Table 5-3: Pre-knowledge scores ANOVA

Groups	*Count*	*Sum*	*Average*	*Variance*
Manikin	10	207.1	20.71	65.45
Human SP	11	239.2	21.75	48.70
Paper-case	11	303	27.55	38.45

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	291.50	2	145.75	2.894	**0.07**	3.33
Within Groups	1460.66	29	50.37			
Total	1752.16	31				

Table 5-4: Post-knowledge scores ANOVA

Groups	*Count*	*Sum*	*Average*	*Variance*
Manikin	10	192.1	19.21	45.96
Human SP	11	283.5	25.77	41.79
Paper-case	11	318.3	28.94	52.21

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	511.09	2	255.55	5.47	**0.01**	3.33
Within Groups	1353.62	29	46.68			
Total	1864.71	31				

Table 5-5: Difference in knowledge scores between scenarios. t-Test: Paired Two Sample for Means (pre/post knowledge scores)

	Manikin scenario		*Human SP scenario*		*Paper-case*	
	Pre knowledge	*Post knowledge*	*Pre knowledge*	*Post knowledge*	*Pre knowledge*	*Post knowledge*
Mean	20.71	19.21	21.75	25.77	27.55	28.94
SD	65.45	45.96	48.70	41.79	38.45	52.21
Observations	10	10	11	11	11	11
Pearson Correlation	0.314		0.83		0.94	
Hypothesized Mean Difference	0		0		0	
df	9		10		10	
t Stat	0.54		-3.37		-1.83	
P(T<=t) two-tail	**0.60**		**0.01**		**0.10**	
t Critical two-tail[12]	2.26		2.23		2.23	

[12] 2-tail tests were used to detect both positive and negative effects

Objective b) To explore whether realism effects learner's knowledge

This study found that there is a difference in learner's knowledge between simulation modalities with different levels of realism, therefore, it can be suggested that realism effects learner's knowledge. There was a significant pre/post knowledge gain following simulation with a Human SP. Between modalities, post-knowledge scores were significantly higher than the Manikin scenario following the Human SP scenario and Paper-case.

5.4 Learner's general self-efficacy

The General Self Efficacy Scale (GSES) (Schwarzer and Jerusalem, 1995) was used to assess the learner's general sense of perceived self-efficacy, with a view to establish whether they were able to cope with the scenarios that were presented to them during the research study. Self-efficacy was self-recorded prior to each of the scenarios and results are displayed in Table 5-6.

Table 5-6: Learner's self-efficacy before each of the three scenarios

ID	GSES Score (Manikin)	GSES Score (Human SP)	GSES Score (Paper-case)
241215	28	29	30
1108	28	29	29
1409	30	30	30
1805	28	28	30
1804	29	29	30
1304	29	30	30
47	29	33	32
859	34	37	40
585	30	29	29
7	31	34	37
1993		31	27
MEDIAN	29	30	30

NB. grey square shows missing data.

Learners were considered to have high self-efficacy. There was no difference in the self-efficacy between the different scenarios (p=0.42, Table 5-7).

Table 5-7: Self-efficacy score ANOVA

Groups	*Count*	*Sum*	*Average*	*Variance*
GSES Score (Manikin)	10	296	29.60	3.38
GSES Score (Human SP)	11	339	30.82	7.56
GSES Score (Paper-case)	11	344	31.27	14.62

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	15.50	2	7.75	0.89	**0.42**	3.33
Within Groups	252.22	29	8.70			
Total	267.72	31				

Objective c) To gain a baseline measure of learner's self-efficacy to explore the effect of self-efficacy on undergraduate student's ability to cope with the challenge of different simulation-based education scenarios

There is no difference in learner's self-efficacy between the simulation modalities included in this study; all learner's reported high levels of general self-efficacy. Whether this contributed to the learner's ability to cope with the challenges experienced during simulation will be discussed in Chapter 7.

5.5 Learner's emotions before and after scenarios

The Geneva Emotion Wheel (GEW) (Scherer, 2005; Scherer et al., 2013) was used to collect emotion data from participants before and immediately following the three scenarios. Data were obtained from twenty emotion families for positive (high and low control) and negative (high and low control) emotions (Table 5-8). Results from the three scenarios are displayed using radar charts. Higher numbers represent a higher intensity of the emotion experienced. Kaczynski et al. (2008) advoke the use of radar charts for comparing changes or differences, while Saary (2008) advocates the use of radar graphing as a 'useful technique' for the presentation of multivariate data related to healthcare (Saary, 2008: 311).

Table 5-8: GEW emotion data for the three scenarios across 20 emotion families

		Positive, high control										**Positive, low control**									
		1		2		3		4		5		6		7		8		9		10	
		Interest		Amusement		Pride		Joy		Pleasure		Contentment		Love		Admiration		Relief		Compassion	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Manikin scenario	SUM	38	40	29	35	22	19	28	31	28	26	30	27	27	28	34	32	23	33	30	33
	MEAN	3.8	4	2.9	3.5	2.2	1.9	2.8	3.1	2.8	2.6	3	2.7	2.7	2.8	3.4	3.2	2.3	3.3	3	3.3
Human SP scenario	SUM	37	31	29	36	24	35	28	33	29	32	29	35	26	28	27	33	21	39	29	35
	MEAN	3.4	2.8	2.6	3.3	2.2	3.2	2.5	3.0	2.6	2.9	2.6	3.2	2.4	2.5	2.5	3.0	1.9	3.5	2.6	3.2
Paper-case	SUM	32	36	26	29	27	30	28	26	29	29	31	31	25	27	27	31	25	29	28	31
	MEAN	2.9	3.3	2.4	2.6	2.5	2.7	2.5	2.4	2.6	2.6	2.8	2.8	2.3	2.5	2.5	2.8	2.3	2.6	2.5	2.8

		Negative, low control										**Negative, high control**									
		1		2		3		4		5		6		7		8		9		10	
		Sadness		Guilt		Regret		Shame		Disappointment		Fear		Disgust		Contempt		Hate		Anger	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Manikin scenario	SUM	12	13	9	11	6	23	5	20	9	18	25	12	5	8	11	9	7	7	8	12
	MEAN	1.2	1.3	0.9	1.1	0.6	2.3	0.5	2	0.9	1.8	2.5	1.2	0.5	0.8	1.1	0.9	0.7	0.7	0.8	1.2
Human SP scenario	SUM	14	6	11	6	11	6	9	9	12	10	27	9	7	3	11	7	8	3	11	4
	MEAN	1.3	0.5	1.0	0.5	1.0	0.5	0.8	0.8	1.1	0.9	2.5	0.8	0.6	0.3	1.0	0.6	0.7	0.3	1.0	0.4
Paper-case	SUM	7	13	6	8	7	9	6	7	6	9	10	5	3	5	8	6	4	4	3	5
	MEAN	0.6	1.2	0.5	0.7	0.6	0.8	0.5	0.6	0.5	0.8	0.9	0.5	0.3	0.5	0.7	0.5	0.4	0.4	0.3	0.5

5.5.1 *Manikin scenario: Positive emotions*

Prior to the Manikin scenario, *Interest* (3.8) was the strongest positive emotion observed. Following the Manikin scenario, a significant intensity increase was observed in *Relief* (2.3 to 3.3, p=0.04) see Table 5-9. Three of the positive, high control emotions (*Interest*, *Amusement* and *Joy*) increased, while *Pride* and *Pleasure* decreased. Positive, low control emotions *Contentment*, and *Admiration* both decreased while *Love*, *Relief* and *Compassion* all increased following the Manikin scenario (see Figure 5-3), although these results were not statistically significant.

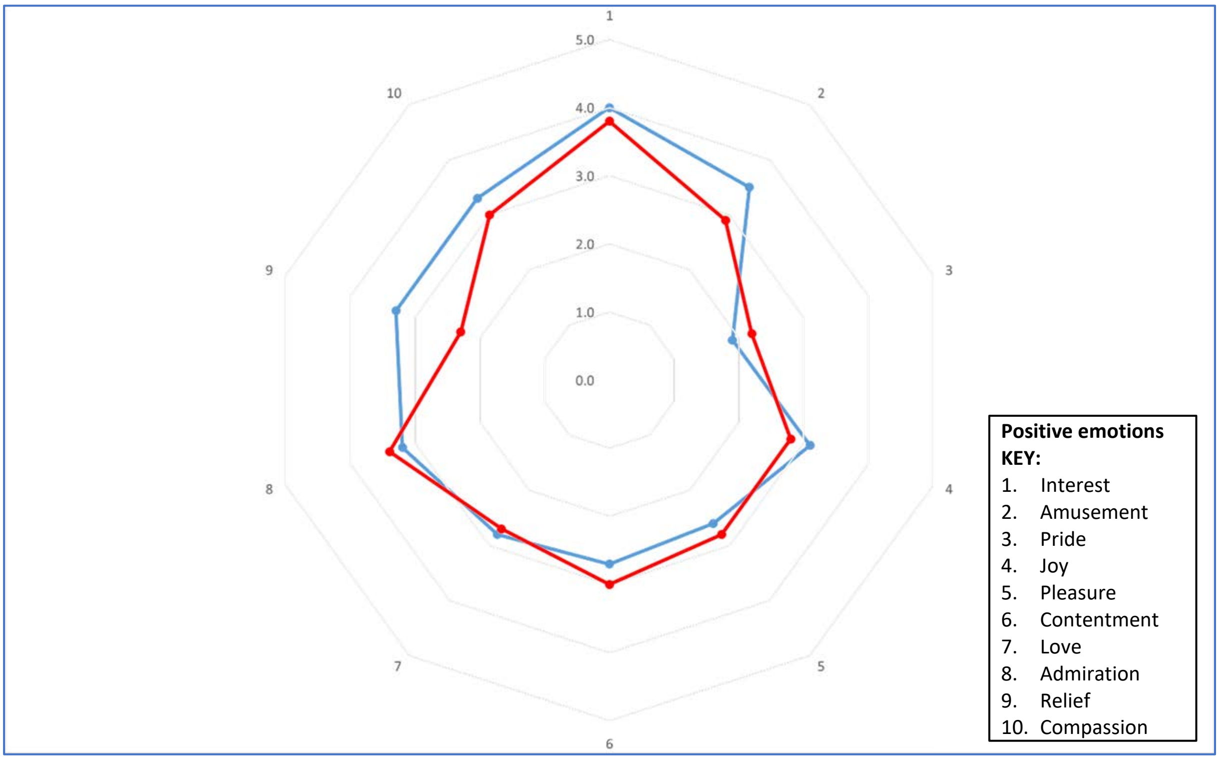


Figure 5-3: Manikin scenario: Positive emotions (pre and post scenario)

Pre-scenario

Post-scenario

Table 5-9: t-Test: Paired Two Sample for Means (pre/post Relief intensity scores)

	Pre-Relief	*Post-Relief*
Mean	2.3	3.3
Variance	3.12	2.01
Observations	10	10
Pearson Correlation	0.67	
Hypothesized Mean Difference	0	
df	9	
t Stat	-2.37	
P(T<=t) two-tail	**0.04**	
t Critical two-tail	2.26	

5.5.2 Manikin scenario: Negative emotions

Fear (2.5) showed the strongest intensity pre-Manikin scenario. All of the negative, low control emotions (*Sadness*, *Guilt*, *Regret*, *Shame*, *Disappointment*) increased following the manikin scenario. There was a significant pre/post increase in the intensity of *Regret* (p=0.02) and *Disappointment* (p=0.05), see Table 5-10. Of the negative, high control emotions, *Disgust*, and *Anger* increased, *Hate* stayed the same and *Contempt* decreased following the Manikin scenario**.** There was a significant decrease in *Fear* (p<0.001, Table 5-10) pre/post-Manikin scenario (see Figure 5-4).

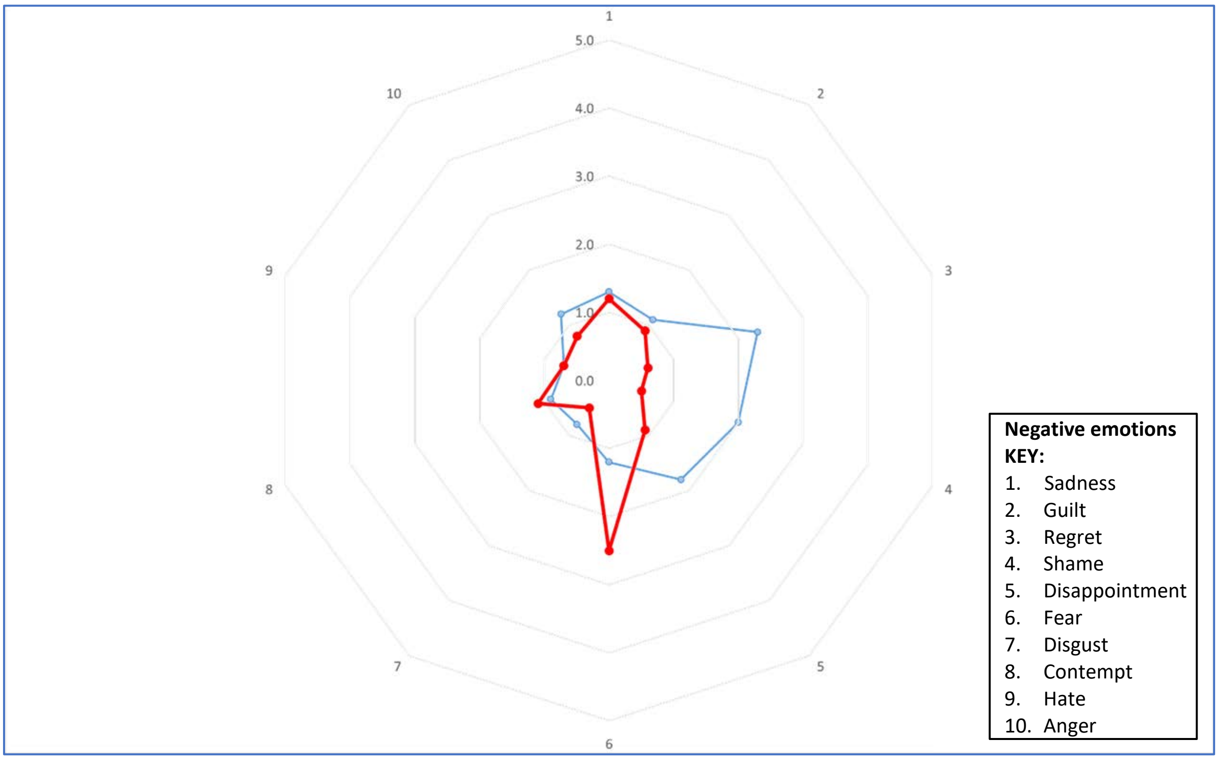


Figure 5-4: Manikin scenario: Negative emotions (pre and post scenario)

Pre-scenario

Post-scenario

Table 5-10: t-Test: Paired Two Sample for Means (pre/post Regret, Disappointment and Fear intensity scores)

	Pre-Regret	*Post-Regret*	*Pre-Disappointment*	*Post-Disappointment*	*Pre-Fear*	*Post-Fear*
Mean	0.6	2.3	0.9	1.8	2.5	1.2
Variance	0.93	2.23	1.66	2.4	2.06	1.07
Observations	10	10	10	10	10.00	10.00
Pearson Correlation	-0.06		0.60		0.68	
Hypothesized Mean Difference	0		0		0.00	
df	9		9		9.00	
t Stat	-2.94		-2.21		3.88	
P(T<=t) two-tail	**0.02**		**0.05**		**<0.001**	
t Critical two-tail	2.26		2.26			

5.5.3 Human SP scenario: Positive emotions

Prior to the Human SP scenario, *Interest* (3.4) was the strongest positive emotion observed, however this decreased (3.4 to 2.8) following the Human SP scenario, although the result was not significant. All other positive emotions (high and low control) increased post-Human SP scenario. The strongest intensity increases were observed in *Relief* (1.9 to 3.5, p<0.001) and *Pride* (2.2 to 3.2, p=0.01) following the Human SP scenario (see Figure 5-5). There were also significant increases in *Contentment* (2.64 to 3.18, p=0.03) and *Compassion* (2.64 to 3.18, p=0.01) (see Table 5-11).

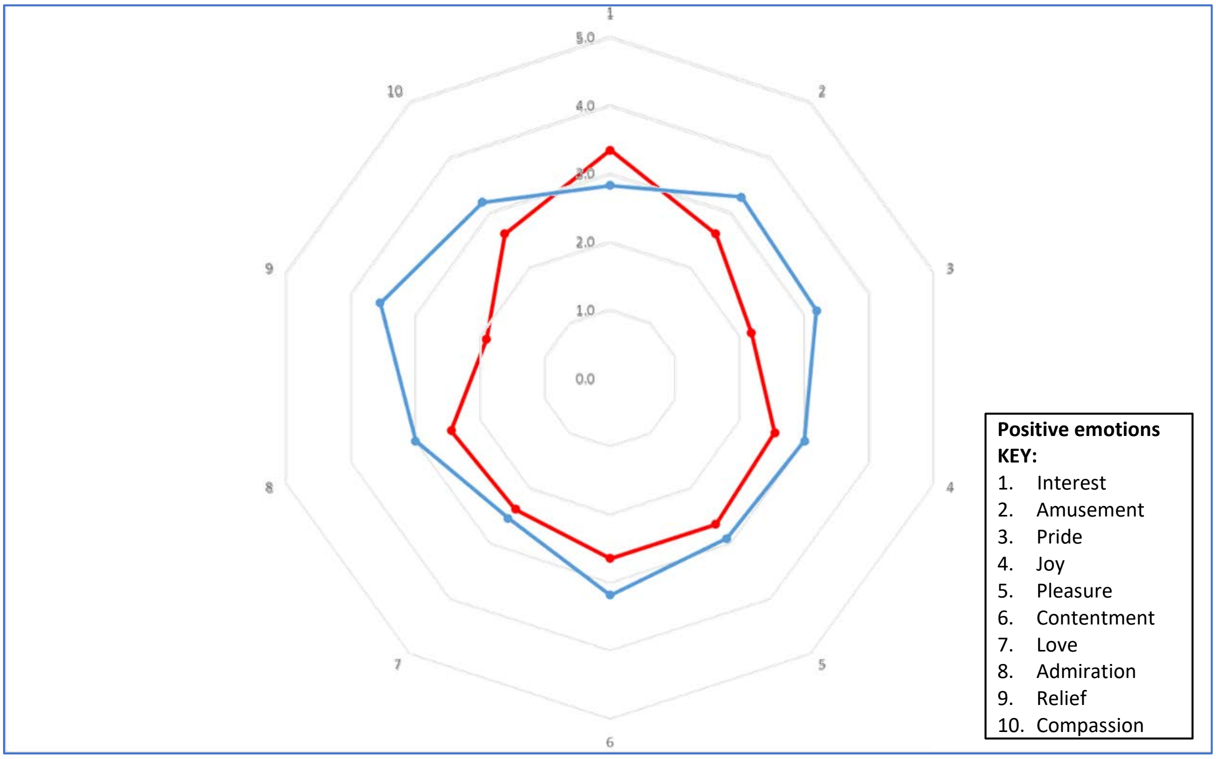


Figure 5-5: Human SP scenario: Positive emotions (pre and post scenario)

Pre-scenario

Post-scenario

Table 5-11: t-Test: Paired Two Sample for Means (pre/post Relief, Pride, Contentment and Compassion intensity scores)

	Pre-Relief	*Post-Relief*	*Pre-Pride*	*Post-Pride*	*Pre-Contentment*	*Post-Contentment*	*Pre-Compassion*	*Post-Compassion*
Mean	1.91	3.55	2.18	3.18	2.64	3.18	2.64	3.18
Variance	2.89	2.27	2.16	2.56	2.25	2.56	3.05	3.96
Observations	11	11	11	11	11	11	11	11
Pearson Correlation	0.76		0.75		0.90		0.97	
Hypothesized Mean Difference	0		0		0		0	
df	10		10		10		10	
t Stat	-4.85		-3.03		-2.63		-3.46	
P(T<=t) two-tail	**<0.001**		**0.01**		**0.03**		**0.01**	
t Critical two-tail	2.23		2.23		2.23		2.23	

5.5.4 Human SP scenario: Negative emotions

Fear (2.5) showed the greatest intensity pre-Human SP scenario. All negative emotions (high and low control) decreased following interaction with the Human SP, except *Shame* (0.8), which stayed the same (see Figure 5-6). There was a significant decrease in *Sadness* (1.3 to 0.5, p=0.05) and *Fear* (2.45 to 0.82, p<0.001), following the Human SP scenario (see Table 5-12).

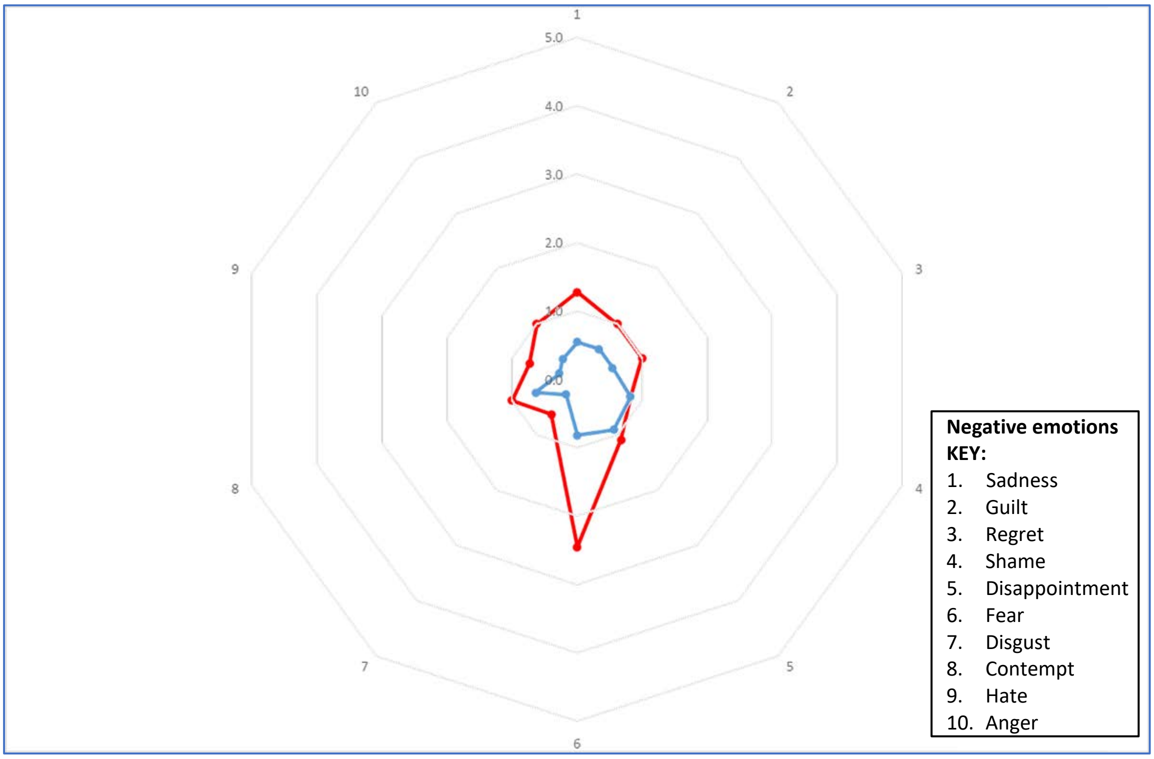


Figure 5-6: Human SP scenario: Negative emotions (pre and post scenario)

Pre-scenario

Post-scenario

Table 5-12: t-Test: Paired Two Sample for Means (pre/post Sadness and Fear intensity scores)

	Pre-Sadness	*Post-Sadness*	*Pre-Fear*	*Post-Fear*
Mean	1.27	0.55	2.45	0.82
Variance	2.62	0.47	3.07	0.96
Observations	11	11	11	11
Pearson Correlation	0.84		0.81	
Hypothesized Mean Difference	0		0	
df	10		10	
t Stat	2.19		4.85	
P(T<=t) two-tail	**0.05**		**<0.001**	
t Critical two-tail	2.23			

5.5.5 Paper-case: Positive emotions

Prior to the Paper-case, *Interest* (2.9) was the strongest positive emotion observed, and this significantly increased (3.3) (p=0.04, Table 5-13) following the Paper-case. Of the positive, high control emotions, post-Paper-case, three emotions (*Interest*, *Amusement*, *Pride*) increased, there was a slight decrease in *Joy* (2.5 to 2.4) whereas *Pleasure* (2.6) stayed the same. Of the positive, low control emotions, *Contentment* (2.8) stayed the same, all other positive, low control emotions (*Love*, *Admiration*, *Relief* and *Compassion*) increased following the Paper case (see Figure 5-7), however these results were not statistically significant.

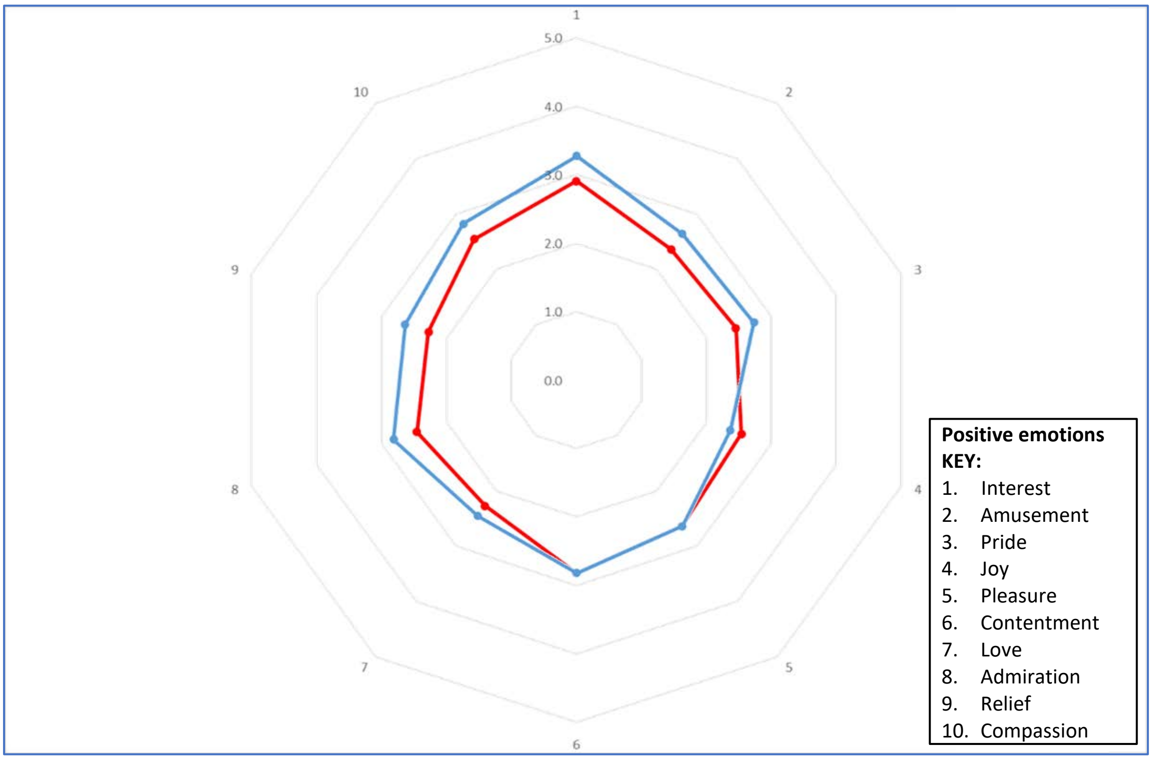


Figure 5-7: Paper-case: Positive emotions (pre and post scenario)

Pre-scenario

Post-scenario

Table 5-13: t-Test: Paired Two Sample for Means (pre/post Interest intensity scores)

	Pre-Interest	*Post-Interest*
Mean	2.91	3.27
Variance	2.89	2.62
Observations	11	11
Pearson Correlation	0.95	
Hypothesized Mean Difference	0	
df	10	
t Stat	-2.39	
P(T<=t) two-tail	**0.04**	
t Critical two-tail	2.23	

5.5.6 Paper-case: Negative emotions

Fear (0.9) showed the greatest intensity pre-Paper-case. There was an increase in all five negative, low control emotions (*Sadness*, *Guilt*, *Regret*, *Shame* and *Disappointment*) following the Paper-case. Of the negative, high control emotions *Fear* (0.9) and *Contempt* (0.7) decreased to 0.7 and 0.5 respectively, while *Disgust* and *Anger* increased slightly, these results were not statistically significant. *Hate* (0.4) remained the same post-Paper-case (see Figure 5-8). The overall intensity of all negative emotions pre- and post-Paper-case were notably less than the other modalities.

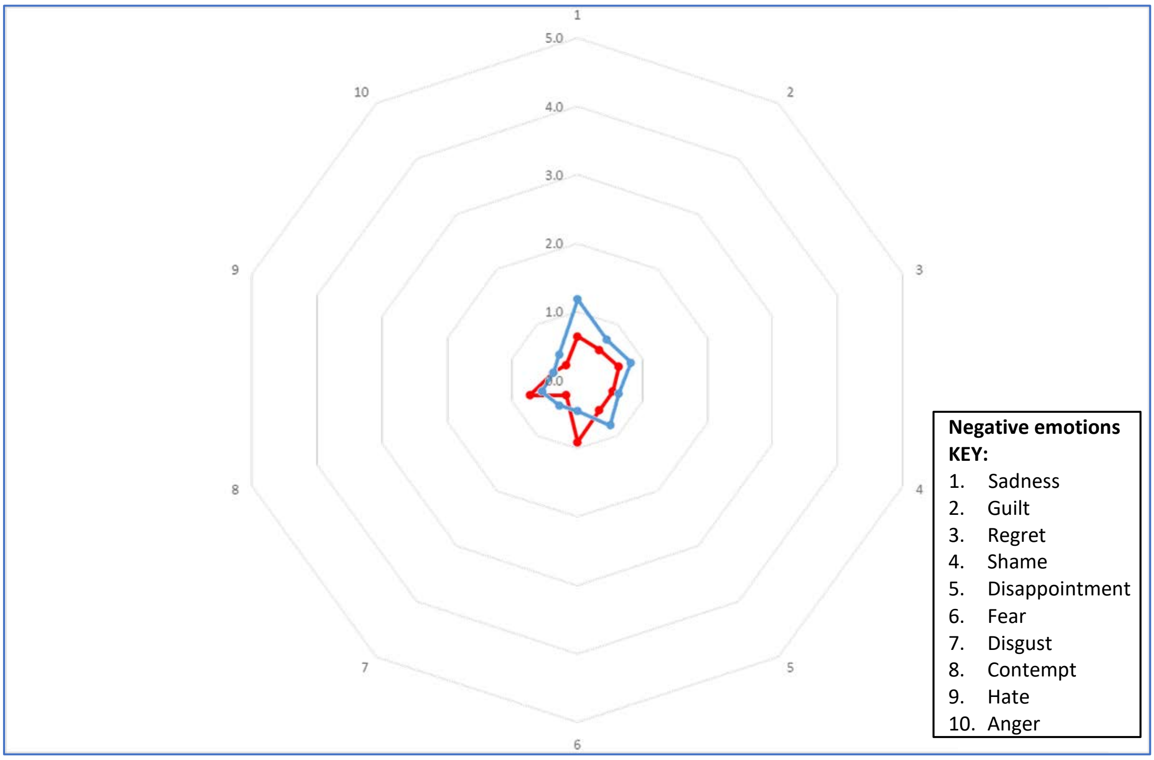


Figure 5-8: Paper-case: Negative emotions (pre and post scenario)

Pre-scenario

Post-scenario

5.5.7 Comparison of emotions between simulation modalities

GEW measures the Intensity of emotions. Figure 5-9 shows a comparison of the intensity of positive and negative emotions experienced prior to and immediately following engagement with three different simulation scenarios. Positive emotions were overall more intense than negative emotions. Interest showed the highest intensity of positive emotions in all three scenarios. In relation to negative emotions, overall, the Paper-case displayed the least intense negative emotions. *Fear* showed the highest intensity of negative emotions in all three scenarios.

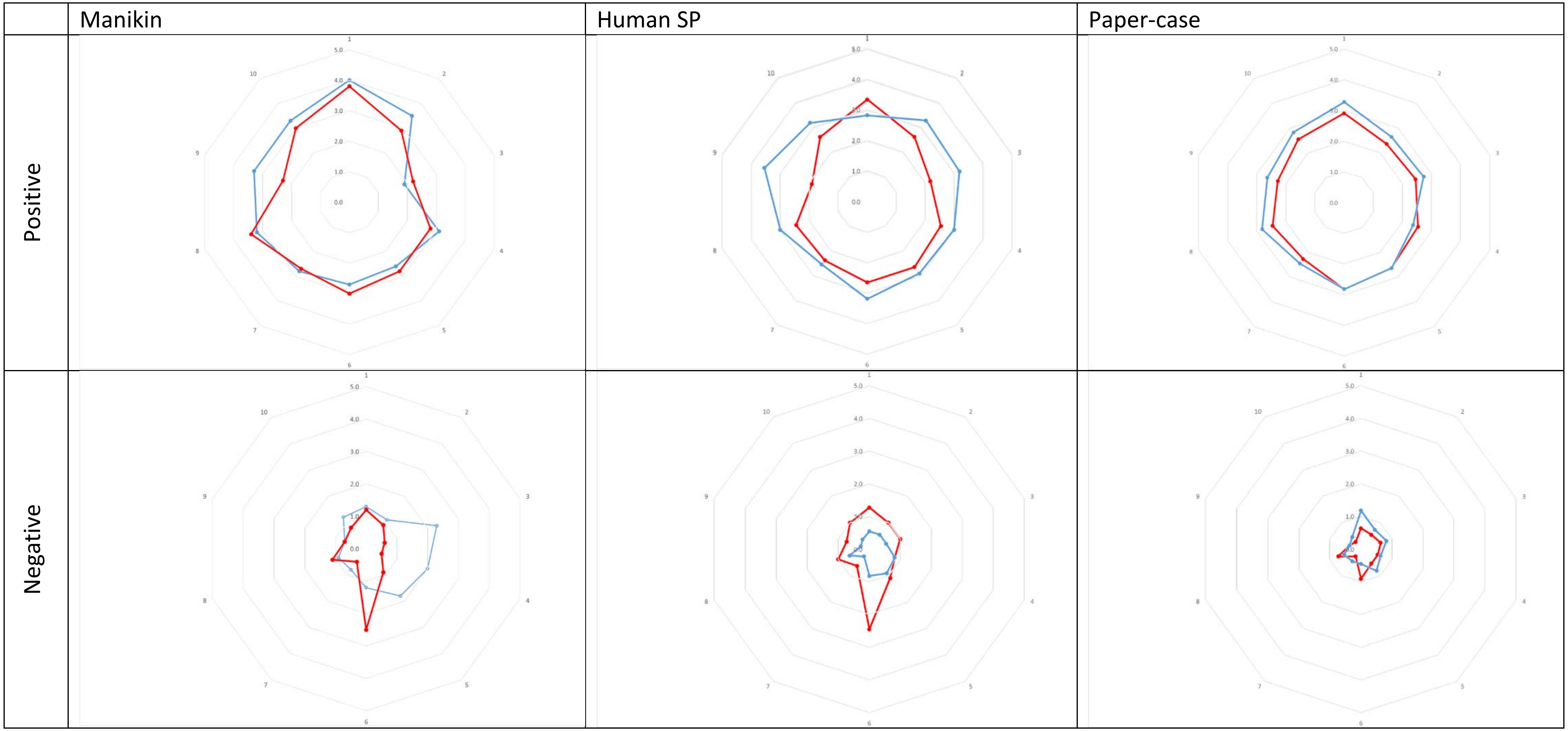


Figure 5-9: Comparison of positive and negative emotions for three modalities

Pre-scenario

Post-scenario

Positive emotions KEY:
1. Interest
2. Amusement
3. Pride
4. Joy
5. Pleasure
6. Contentment
7. Love
8. Admiration
9. Relief
10. Compassion

Negative emotions KEY:
1. Sadness
2. Guilt
3. Regret
4. Shame
5. Disappointment
6. Fear
7. Disgust
8. Contempt
9. Hate
10. Anger

Regarding the positive emotion, *Interest*; there was no significant difference between the intensity of this emotion prior to the three scenarios (p=0.42, Table 5-14). There was also no significant difference (p=0.28, Table 5-15) between the intensity of *Interest* emotion following the three scenarios.

Table 5-14: Pre-Interest emotion scores ANOVA

SUMMARY

Groups	*Count*	*Sum*	*Average*	*SD*
Manikin	10	38	3.80	1.29
Human SP	11	37	3.36	2.65
Paper-case	11	32	2.91	2.89

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4.16	2	2.08	0.90	**0.42**	3.33
Within Groups	67.05	29	2.31			
Total	71.22	31				

Table 5-15: Post-Interest emotion scores ANOVA

SUMMARY

Groups	*Count*	*Sum*	*Average*	*SD*
Manikin	10	40	4.00	0.89
Human SP	11	31	2.82	4.76
Paper-case	11	36	3.27	2.62

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7.40	2	3.70	1.31	**0.28**	3.33
Within Groups	81.82	29	2.82			
Total	89.22	31				

There was no significant difference between the intensity of *Fear* prior to both the Manikin and Human SP scenarios (p=0.95, see Table 5-16), however, *Fear* was significantly less intense prior to the Paper-case when compared to the other two modalities (p=0.03, Table 5-17).

Table 5-16: t-Test: Two-Sample Assuming Unequal Variances[13] (pre-Fear intensity scores Manikin/Human SP)

	Manikin	*Human SP*
	Pre-Fear	*Pre-Fear*
Mean	2.50	2.45
Variance	2.06	3.07
Observations	10.00	11.00
Hypothesized Mean Difference	0.00	
df	19.00	
t Stat	0.07	
P(T<=t) two-tail	**0.95**	
t Critical two-tail	2.09	

Table 5-17: Pre-Fear emotion scores ANOVA

SUMMARY

Groups	*Count*	*Sum*	*Average*	*SD*
Manikin	10.00	25	2.50	2.06
Human SP	11.00	27	2.45	3.07
Paper-case	11.00	10	0.91	1.69

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	17.74	2	8.87	3.89	**0.03**	3.33
Within Groups	66.14	29	2.28			
Total	83.88	31				

The graph in Figure 5-10 shows the intensity of *Interest* emotion prior to and following the three scenarios. *Interest* intensity increased following the Manikin scenario, however, this difference was not significant (p=0.59, Table 5-18). *Interest* scores decreased following the Human SP scenario, again, this decrease was not statistically significant (p=0.35, Table 5-18). It was noted that *Interest* intensity significantly increased following the Paper-case (p=0.04, Table 5-18).

[13] Two-Sample Assuming Unequal Variances t-Test was used as the number of data points were different between the two groups.

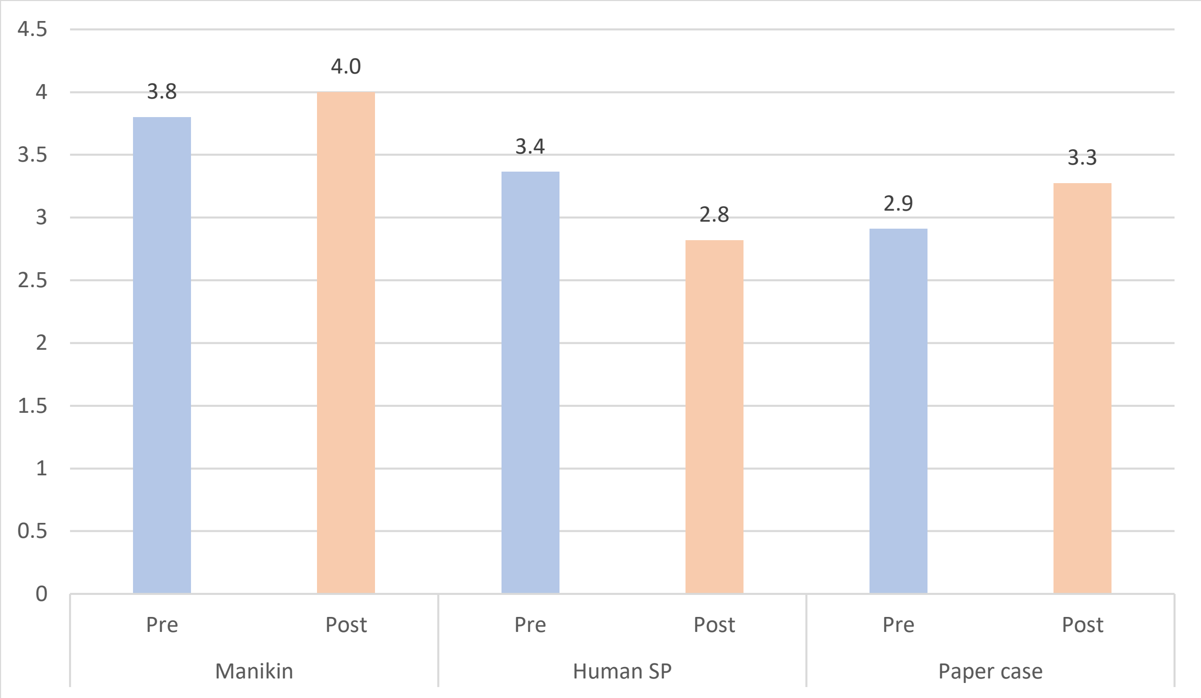


Figure 5-10: Mean Interest intensity scores (pre and post scenario)

Table 5-18: t-Test: Paired Two Sample for Means (pre/post Interest intensity scores)

	Manikin		Human SP		Paper-case	
	Pre-Interest	*Post-Interest*	*Pre-Interest*	*Post-Interest*	*Pre-Interest*	*Post-Interest*
Mean	3.8	4	3.36	2.82	2.91	3.27
Variance	1.29	0.89	2.65	4.76	2.89	2.62
Observations	10	10	11	11	11	11
Pearson Correlation	0.42		0.55		0.95	
Hypothesized Mean Difference	0		0		0	
df	9		10		10	
t Stat	-0.56		0.97		-2.39	
P(T<=t) two-tail	**0.59**		**0.35**		**0.04**	
t Critical two-tail	2.26		2.23		2.23	

The graph in Figure 5-11 shows the intensity of *Fear* prior to and following the three scenarios. *Fear* intensity significantly decreased following both the Manikin scenario and the scenario with a Human SP ($p<0.001$, Table 5-19); although *Fear* intensity reduced following the Paper-case, this difference was not statistically significant ($p=0.1$, Table 5-19).

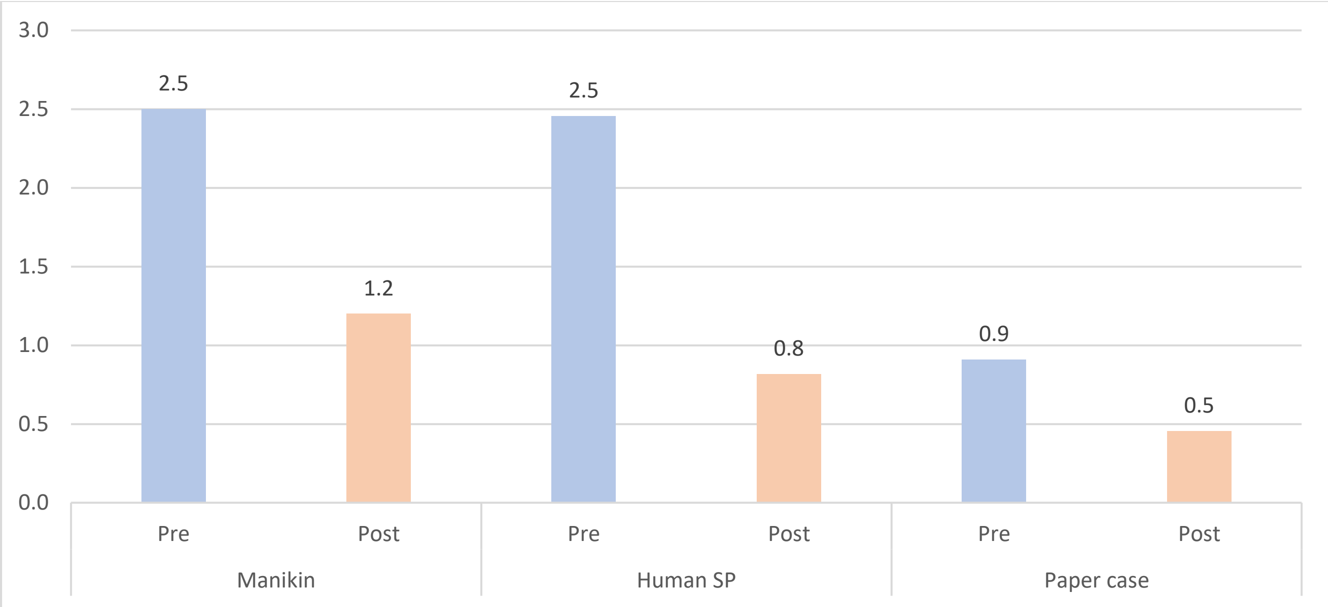


Figure 5-11: Mean Fear intensity scores (pre and post scenario)

Table 5-19: t-Test: Paired Two Sample for Means (pre/post Fear intensity scores)

	Manikin		*Human SP*		*Paper case*	
	Pre-Fear	*Post-Fear*	*Pre-Fear*	*Post-Fear*	*Pre-Fear*	*Post-Fear*
Mean	2.50	1.20	2.45	0.82	0.91	0.45
Variance	2.06	1.07	3.07	0.96	1.69	0.67
Observations	10.00	10.00	11.00	11.00	11.00	11.00
Pearson Correlation	0.68		0.81		0.79	
Hypothesized Mean Difference	0.00		0.00		0.00	
df	9.00		10.00		10.00	
t Stat	3.88		4.85		1.84	
P(T<=t) two-tail	**<0.001**		**<0.001**		**0.10**	
t Critical two-tail	2.26		2.23		2.23	

Objective d) To gather data on the intensity of learner's emotions before and after engaging with different simulation-based education scenarios

To summarise, there is a difference in the intensity of learner's emotions both pre/post simulation and between simulation modalities.

5.6 Learner's behaviour during scenarios

Learner's behaviours and actions were audio/video (AV) recorded and observed during the scenarios, analysis was conducted post-simulation. Both structured and unstructured observation methods were used to gather data. Quantitative observation data will be discussed below, whereas qualitative data obtained via structured and unstructured methods will be presented in Chapter 6.

5.6.1 Structured observation

The Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS) system (Mitchell et al., 2013) was used to assess learner's performance and behaviours in each of the scenarios. SPLINTS is divided into Categories and Elements. There are three Categories: Situational Awareness; Communication and Teamwork; and Task Management. Each of the categories has three Elements, as discussed in Chapter 4. Learners were rated on a scale from 1 to 4, where 1 = Poor, 2 = Marginal, 3 = Acceptable, and 4 = Good. The maximum Category score is 12 and the minimum Category score is 3. The maximum score for all 9 Elements is 36, and the minimum Element score is 9. Written feedback on performance was also noted. Results from the SPLINTS observation scores are presented in Table 5-20.

Table 5-20: SPLINTS observation tool scores

	SPLINTS Category Scores (Min. = 3, Max. 12)			SPLINTS Element Scores (Min. 9, Max. 36)		
	Manikin Scenario	Human SP scenario	Paper-case	Manikin Scenario	Human SP scenario	Paper-case
	11	11	12	34	34	33
	9	11	11	27	34	34
	11	11	8	33	31	24
	7	12	10	20	35	31
SUM	38	45	41	114	134	122
MEAN	**9.5**	**11.25**	**10.25**	**28.5**	**33.5**	**30.5**

Learner's performance was rated highest in the Category rating in the Human SP scenario (11.25), followed by the Paper-case (10.25) then the Manikin scenario (9.5). Element scores followed the same pattern with learners scoring the highest in the Human SP scenario (33.5), followed by the Paper-case (30.5) and then the Manikin scenario (28.5). The differences between the Category scores (p=0.31) for all scenarios and Element scores for all scenarios (p=0.35) were not statistically significant (Tables 5-21 and 5-22). This indicated that there was no difference in the learner's performance during the scenarios. Learner's behaviours will be explored in greater depth in Chapter 6, where the themes that arose during the scenarios will be described.

Table 5-21: ANOVA, Single Factor (SPLINTS Category Scores)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Manikin scenario	4	38	9.5	3.67
Human SP scenario	4	45	11.25	0.25
Paper-case	4	41	10.25	2.92

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	6.17	2	3.08	1.35	**0.31**	4.26
Within Groups	20.5	9	2.28			
Total	26.67	11				

Table 5-22: ANOVA, Single factor (SPLINTS Element Scores)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Manikin scenario	4	114	28.5	41.67
Human SP scenario	4	134	33.5	3
Paper-case	4	122	30.5	20.33

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	50.67	2	25.33	1.17	**0.35**	4.26
Within Groups	195	9	21.67			
Total	245.67	11				

Objective e) To observe learner's behaviour during simulation-based education

There is no significant difference between the learner's behaviour scores, however, this objective will be fully explored following the qualitative data analysis in Chapter 6.

5.7 Chapter summary

The following Table (5-23) summarises the findings from the quantitative strand of the study, which intend to address Objectives a) to d) regarding realism of the scenarios, learner's knowledge, self-efficacy, and emotions. These findings will be discussed in detail in Chapter 7 and integrated with the qualitative findings that are presented and address Objective e), in Chapter 6.

Table 5-23: Summary of quantitative findings

	Manikin scenario	**Human SP scenario**	**Paper-case**
Objective a)	To identify any differences in realism between three simulation modalities		
Realism of scenarios	Mid Realism score=42	High Realism score=51 Significantly more realistic than Manikin scenario and Paper-case ($p<0.001$)	Low Realism score=26 Least realistic
Objective b)	To explore whether realism effects learner's knowledge		
Learner's knowledge	• Pre-scenario knowledge score=21 • Post-scenario Knowledge score=19 • Knowledge scores decreased post-Manikin scenario (NS, p=0.6)	• Pre-scenario knowledge score=22 • Post-scenario Knowledge score=26 • Knowledge scores significantly increased from pre/post-Human SP scenario (p=0.01) • Knowledge score significantly higher post-Human SP scenario compared with Manikin scenario (p=0.01)	• Pre-scenario knowledge score=28 • Post-scenario Knowledge score=29 • Knowledge scores increased from pre/post-Paper-case (NS, p=0.1) • Knowledge score significantly higher post-Paper-case compared with Manikin and Human SP scenarios (p=0.01)
Objective c)	To gain a baseline measure of learner's self-efficacy to explore the effect of self-efficacy on undergraduate student's ability to cope with the challenge of different simulation-based education scenarios		
Learner's self-efficacy	• Median = 29 High self-efficacy, able to cope with stressful life events	• Median = 30 High self-efficacy, able to cope with stressful life events	• Median = 30 High self-efficacy, able to cope with stressful life events

	Manikin scenario	Human SP scenario	Paper-case
Objective d)	To gather data on the intensity of learner's emotions before and after engaging with different scenarios		
Learner's emotions	**Positive**: *Interest* strongest intensity pre-scenario (3.8) and increased post-scenario (4.0) (NS, p=0.59). *Relief* significantly increased pre/post (2.3-3.3) (p=0.04)	**Positive:** *Interest* strongest intensity pre-scenario (3.4) and decreased post-scenario (2.8) (NS, p=0.35). *Relief* significantly increased pre/post (1.9-3.5) (p<0.001). All other positive emotions (high and low control) increased post-scenario, including: *Pride* significantly increased (p=0.01) *Contentment* significantly increased (p=0.03) *Compassion* significantly increased (p=0.01)	**Positive**: *Interest* strongest intensity pre-scenario (2.9) and significantly increased post-Paper-case (3.3) (p=0.04)
	Negative: *Fear* strongest intensity (2.5), significantly decreased post-scenario (1.2) (p<0.001). All negative, low control emotions increased post-scenario, including: *Regret* significantly increased pre/post (p=0.02) *Disappointment* significantly increased (p=0.05) pre/post	**Negative:** *Fear* strongest intensity (2.5), significantly decreased post-scenario (0.8) (p<0.001). 9/10 negative emotions (high and low control) decreased post-scenario, including: *Sadness*, which significantly decreased (p=0.05) pre/post	**Negative**: *Fear* (0.9) significantly less intense prior to Paper-case (0.5) (p=0.03). Overall, all negative emotions pre- and post-Paper-case were less intense than the other modalities
Objective e) (Not yet fully explored)	To observe learner's behaviour during simulation-based education		
Learner's behaviour	Low performance rating Category=9.5 (NS, p=0.31) Element=28.5 (NS, p=0.35)	High performance rating Category=11.25 (NS, p=0.31) Element=33.5 (NS, p=0.35)	Mid performance rating Category=10.25 (NS, p=0.31) Element=30.5 (NS, p=0.35)

Note: NS = not significant

CHAPTER 6 - FINDINGS FROM THE QUALITATIVE STRAND OF THE STUDY

6.0 Chapter overview

This chapter presents the findings from the qualitative strand of the main research study; it includes analysis of written feedback from the SPLINTS system (Mitchell et al., 2013), which was used for structured observations and the thematic analysis of twelve transcripts generated from four group's interactions during the three scenarios (Manikin scenario, Human SP scenario and Paper-case). These findings generated data that help to answer the overarching research question, and specifically Objective e) To observe learner's behaviour during simulation-based education. The theoretical framework underpinning this strand of the study is based on Bandura's Social Learning Theory (SLT), related to behavioural factors, personal factors, and environmental factors (Bandura, 1977a). Analysis of the qualitative data was guided by Braun and Clarke's (2006) six-step process for thematic analysis. Further discussion, synthesis, and integration of both the quantitative and qualitative data is provided in Chapter 7. The qualitative findings aim to provide a deeper understanding of learner's actions and behaviours during three different scenarios, to create a richer picture of the effect of realism on learner's behaviours.

6.1 Structured observation: written feedback on performance

The SPLINTS system (Mitchell et al., 2013) offers opportunity for observers to record written feedback as well as quantify the scores for each Category and Element. The SPLINTS system was used as a framework for structured observation of learner's actions and behaviours during the three scenarios. The written feedback from SPLINTS was also utilised to frame the debrief for learners following the two physical simulation scenarios (Manikin and Human SP scenarios). The quantitative SPLINTS data was presented in Chapter 5. The qualitative data has also been analysed and is presented below with extracts from the observer's feedback to illustrate salient points. The SPLINTS raw data can be found in Appendix L. As described in Chapter 4, learners attended simulation sessions over a three-week period. Each week they were randomly allocated to four smaller groups of two or three learners to enter the scenarios, in order to keep the number of people in each scenario realistic. This meant that the scenarios were repeated four times each week for the physical scenarios (Manikin and Human SP scenarios). Learners experienced the Manikin scenario first, followed by the Human SP scenario the following week; the Paper-case was presented in week three and all four groups completed it concurrently. Learners did not know the simulation modality prior to entering the scenarios, only that the same simulated patient, Mr Levi Williams, featured in all three scenarios.

6.1.1 SPLINTS system, Category 1: Situational Awareness

During the Manikin scenario all four groups of learners collected information from the daughter and patient in order to gain an understanding of the situation that they had entered. The learners were observed to be recognising cues that were presented to them, they also responded to prompts. For example, learners took the patient's physiological observations and used their clinical judgement to recognise that he was deteriorating; they responded by changing the patient's position to attempt to improve his breathing or by calling for help. Half of the groups (2/4) during the Manikin scenario recognised the urgency of the situation and escalated appropriately by calling 999 for an ambulance. Two groups did not acknowledge the urgency of the patient's deteriorating condition; however, they recommended a referral to other health care professionals:

> *Doesn't think ahead to predict what might happen BUT suggests call to GP and Speech and Language Therapy*
>
> ('Recognising and understanding information' Element– Group 2)

The extract above demonstrates that learners in Group 2 were recognising and understanding the information that was presented during the scenario. Whilst they may not have anticipated a deterioration in the patient's condition, learners in all four groups were observed to respond when they recognised the patient's needs, by either calling for urgent help or referring back to other health care services. Some learners may have found this outside of their scope of Physiotherapy practice, or they may have been unaware of how to appropriately call for help during this simulation.

During the Human SP scenario all four groups asked questions, for example, enquiring how the patient was feeling and if he had slept well. They collected information from the nurse and human SP and interpreted previous physiological observations. 2/4 groups decided to re-assess the patient's physiological observations in order to gather more information about his current health status during the scenario. Three groups anticipated the need to prepare the area prior to moving the patient from the bed:

Gets shoes ready before moving patient, moves chair to other side of bed

('Anticipating' Element - Group 3)

Recognises need for space and slippers prior to moving patient & requirement for three people to assist

('Anticipating' Element - Group 4)

These groups were observed to be forward planning and performing risk assessments in order to safely prepare the area, which was an important point to note. Learners carried out actions, for example, getting the patient's shoes ready for him to wear when he got up out of bed to prevent him from slipping, moving the chair into the correct position so he could sit down and moving equipment out of the way, so he could manoeuvre without risk of harm. These all had a positive impact on patient safety. All four groups recognised cues and responded to cues from the environment, equipment, embedded nurse facilitator and simulated patient.

During the Paper-case all four groups were observed to be reading the case in detail and picking up on cues that were presented in the case. There was an audible difference in the way learners read the Paper-case; two groups read in silence, while two groups read out loud and discussed points of interest as they went along. All four groups made written notes and listed problems and actions. One of the groups had notable depth of discussion about certain elements of the Paper-case related to the patient's physiological observations. This discussion may have been due to a lack of understanding about abbreviations and differences in UK practice, or was perhaps related to lack of preparation prior to the Paper-case, however, learners were observed to struggle to comprehend some of the terminology:

Asked questions when in doubt, picked up on cues & prompts BUT some confusion about observations and abbreviations e.g. PEARL, CRT (cultural differences?)

('Recognising and understanding information' Element – Group 4)

Group 4, comprised exclusively of international students, were observed to encounter more difficulty than the other three groups when trying to clarify some elements of the Paper-case, such as abbreviations and acronyms within the patient notes. For example, they faced difficulties with the terms MRSA, (Methicillin-Resistant Staphylococcus Aureus), a type of bacterial infection; PEARL, (Pupils Equal And Reactive to Light); CRT, (Capillary Refill Time); and UO, (urine output). All of these abbreviations and acronyms are commonly used in healthcare in the UK. This depth of understanding could be attributed to many factors including cultural differences, previous education, knowledge deficit or general confusion, which will be explored later in this chapter.

6.1.2 SPLINTS system Category 2: Communication and Teamwork

During the Manikin scenario, there were some good examples of clear communication with both the patient and his daughter and the groups of learners. For example, learners spoke clearly, using an appropriate volume and were polite and professional. Learners also recognised their own limitations, noting, for example, their own professional boundaries and limitations in the equipment or resources they had access to at the patient's home. Three of the groups introduced themselves to the patient and his relative upon entering the scenario and three groups gained consent from the patient prior to carrying out any tasks. There were some examples of use of positive, assertive language and actions and clear instructions:

Introduces themselves. Provides team members, daughter and patient with clear information, uses appropriate language to explain what they are doing

('Exchanging information' Element – Group 2)

This extract from the SPLINTS system structured observation illustrates that this group were able to exchange information effectively. They did this by providing instructions in easy-to-understand language without using technical terms and providing clear explanations for their requests and actions. Not all groups were as effective at exchanging information; some used non-assertive language and lacked clarification, which caused confusion for other learners and the patient. Learners were also observed to be supporting one another during the Manikin scenario, for example, by assisting with tasks, passing equipment, taking turns, and stepping in to provide help when needed.

In the Human SP scenario, again three of the groups introduced themselves to the patient and nurse upon entering the simulated hospital environment and gained consent from the patient prior to performing any tasks. Learners gave clear instructions to the patient, and encouraged and reassured him:

Allocates roles, clear communication between patient and Team, encourages/reassures patient (‘Co-ordinating with others’ Element – Group 1)

This reassurance and encouragement were in the form of expressive language, for example, learners were observed to complement the patient when he successfully managed to complete a task that they had set for him, using phrases like ‘well done’ ‘excellent’ and ‘this is brilliant’. This encouragement and positive reinforcement were not present during the Manikin scenario, which could be accounted to the fact that the manikin patient was not as realistic as the human SP or perhaps the Manikin scenario itself did not lend itself to the learners encouraging the patient as he was unwell and deteriorating. There were some also examples of non-assertive language used during the Human SP scenario:

Sometimes uses non-assertive language, e.g. ‘can we do, shall we’… (‘Acting Assertively’ Element – Group 3)

Some learners were observed to use an enquiry-based style of communication, rather than using direct instructions during the Human SP scenario. The example above shows learners in Group 3 used the phrases ‘can we do…’ and ‘shall we…’, as opposed a more assertive style, for example, ‘this is what we are going to do…’. This difference in language style witnessed between the scenarios can be attributed to many factors including the urgency of the situation during the Manikin scenario, the physical differences between the manikin and human SP and how comfortable the learners felt in their own abilities and clinical decision-making during the scenarios.

There were some good examples of team-working in all three scenarios, however, during the Human SP scenario, one group demonstrated a clear team-leader. All groups during the three different scenarios asked for help from each other when required. During both physical scenarios (Manikin and Human SP), learners requested assistance or additional information from the embedded facilitators, which helped to guide them during the scenarios. The use of language will be discussed in more detail when exploring the Category of Communication and Teamworking and Theme 3, Verbal and non-verbal communication. Support from a facilitator will also be discussed in Theme 6, Engagement with the scenario.

The Paper-case allowed an opportunity for extensive and detailed discussion between group members, which was not available during the Manikin and Human SP scenarios. This was perhaps due to the face-paced nature, time-pressure and demands on learners' physical skills. In contrast, during the Paper-case, learners assisted each other verbally and discussed ideas and alternative options in detail:

Listened and actively engaged with each other, helped each other out

('Co-ordinating with others' Element – Group 1)

Discussed options and ideas together & helped each other out

('Exchanging information' Element – Group 2)

These extracts illustrate that the learners were observed to be listening, actively engaging in conversation, assisting each other, and discussing options. These communication strategies positively affected the Paper-case as they enabled to learners to work together, make sense of the case, and design a clear action plan for Levi's future care delivery.

During the Paper-case two of the groups acknowledged their own limitations related to the process for reporting safeguarding concerns, which was a positive as learners must have felt comfortable to voice their own lack of knowledge or need for additional training. During the Paper-case it was sometimes difficult to discern what the learners were saying, with one group observed to be talking quietly. There was also noticeable silence, which was not present during the Manikin and Human SP scenarios:

Mumbling, whispering, lots of silence, seemed disengaged

('Exchanging information' Element – Group 3)

Group 3 seemed to lack engagement during the Paper-case, with examples of murmuring and whispering observed, which could be linked to their lack of understanding of the case, their general buy-in to the overall situation or other personal factors. The use of silence noted in the extract above will be explored in more depth in Theme 3, Verbal and non-verbal communication.

Conversely, during the Paper-case the other three groups engaged well and spoke confidently and clearly. One group removed the staple holding the paperwork together, so that they could spread the paper out on the table and engage with it more effectively. Another group adjusted their seating position in the room, so that all group members could actively engage with each other and the scenario:

Adjusted seating so whole group could see the paper case, and actively engaged with each other (‘Co-ordinating with others’ Element – Group 4)

Engagement with the scenario will be explored in Theme 6. The ways in which learners engaged with the different scenarios could be attributed to the presence of an embedded facilitator during simulation-based education activities to support the learners and actively encourage engagement with the tasks. As a facilitator was not present in the room during the Paper-case, this may explain why some students disengaged.

6.1.3 SPLINTS system Category 3: Task Management

All four groups were observed to be calm and composed throughout the Manikin scenario and there was clear delegation of tasks. For example, in one of the observed groups, one learner took the patient’s physiological observations, while another group member communicated with the simulated patient’s daughter. In addition, learners were observed to be talking calmly, economically, and respectfully with the patient and his family member. None of the groups controlled the volume of the radio, which was included to create the sounds of a realistic home environment and as a deliberate distractor during the Manikin scenario. Two of the groups arrived at the simulated home environment prepared and used the kit that was provided to assess the patient. The other two groups were observed to be unprepared, however there were some good examples of overcoming difficulties, which were noted:

Demonstrates difficulty in locating required equipment, unprepared, doesn't bring kit (stethoscope, pen, paper to write observations) with them BUT overcomes difficulties to carry out most of assessment

('Planning and preparing' Element - Group 2)

A kitbag containing equipment required for the scenario was handed to the learners prior to entering the scenario, however, one group appeared to have misplaced the kitbag and did not arrive at the simulated home environment with the equipment. These learners found it more difficult to fully complete the patient assessment as they had no stethoscope, they were not able to write down the results of their observations as they had no pen or paper, and they were not able to safely care for the patient as they had no access to personal protective equipment (PPE). Another group did not find the pen that had been provided to write down Levi's physiological observations, this group tried to memorise the data instead. These factors will be explored in more detail in Theme 5, Patient safety.

During the scenario with a Human SP, all four groups demonstrated evidence of planning and structure to their assessment of the patient, with some opting to use a formal process for patient assessment, while others utilised the National Early Warning Score (NEWS) chart, which was available on the clipboard with patient notes, to structure their assessment and as an aide-mémoire to remind the learners of which observations to take. Two of the groups considered personal hygiene and infection control, which was evidenced by learners in these groups washing their hands and putting on PPE (aprons and gloves) prior to coming into physical contact with the human SP. This contrasted with the Manikin scenario, where none of the learners in any of the groups washed their hands or wore PPE prior to physical contact with the manikin patient in a home environment. During the Human SP scenario, the learners were all aware of the patient's main objective to get up out of bed and 3/4 groups achieved this objective, assisting the patient, so he was able to sit in a chair by the end of the scenario, while the other group assisted Levi so that he was sat up on the side of the bed ready for rehabilitation exercises. They were all aware of the time-pressures and reacted appropriately to the patient's requests:

Recognises time pressure to get patient in chair before lunch time

('Coping with pressure' Element - Group 3)

A requirement of the scenarios was to complete the learning objectives in the allocated timeframe. Recognising time pressures, as noted in the above extract, task management and responding cues are complex skills. Cues from the embedded facilitators were key, to guide and push the learners to achieve the learning objectives. Without the verbal cues from embedded facilitators regarding time management, the learners struggled to keep to the time limit of twenty minutes per scenario, which occurred during the Paper-case, where some groups ran out of time and did not complete all of the assigned tasks.

Furthermore, during the Paper-case there were some examples of unprofessional behaviours observed, and some learners appeared to lose their focus, became distracted and went off-topic:

No urgency to complete scenario, went off-topic, not focussed on tasks. Appeared unprofessional & disengaged

(‘Coping with pressure’ Element - Group 3)

Spent too much time on first part of scenario, so ran out of time. Remained calm, some unprofessional behaviours, e.g. checking mobile phone

(‘Coping with pressure’ Element - Group 4)

The extracts above highlight that some learners in Groups 3 and 4 struggled to engage with the Paper-case and their behaviours appeared somewhat unprofessional, for example, one learner checked their phone in Group 4, and two learners in Group 3 went off-topic to discuss areas not linked to the Paper-case, reflecting back on their ability to physically write as they were accustomed to typing on a computer. Despite this, all four groups wrote notes and developed an action plan. Safeguarding and patient safety were discussed by all groups in relation to the Paper-case, these discussions demonstrated a need for additional learning and support regarding safeguarding, which will be discussed in Theme 1, Knowing how and when to raise concerns (Section 6.2.1). Theme 5, Patient safety, will also be explored in using unstructured observations in Section 6.2.5.

The written feedback on performance from the SPLINTS system (Mitchell et al., 2013) was useful for gaining an overview of the observational data linked to three general Categories and nine Elements that were observed during the three scenarios. This data has provided a framework for the structured observations of learner's behaviours during three different scenarios linked to one simulated patient. The three Categories from the SPLINTS system (Mitchell et al., 2013) will now be used to frame a detailed exploration in order to gain a greater understanding of the learner's behaviours, actions, thoughts, and feelings during the three scenarios. Qualitative data and themes extracted from the transcripts will be presented in section 6.2.

6.2 Unstructured observation

Following the structured observation using the SPLINTS system (Mitchell et al., 2013), the audio and video recorded data was transcribed verbatim to further investigate the behaviours that occurred during the three scenarios. In addition to verbatim transcription, notes on the learner's objectives, environment, position in the rooms, and social differences including clothing, hair style (in keeping with the uniform policy), and speech and language patterns were also documented. Three approaches to the qualitative data analysis were taken; a deductive approach (Caulfield, 2022) whereby preconceived themes from the structured observation categories, namely, Situational Awareness; Communication and Teamwork; and Task Management, were translated to the transcripts. Induction was also used to determine new arising themes and subthemes, and a latent approach was used to identify and examine the social data to gain an understanding of underlying thoughts, assumptions, and concepts revealed from inferences in the data (Caulfield, 2022). The latent approach enabled a deeper understanding of the learner's actions, behaviours and assumptions that were concealed in the data, and not identified using the structured observational method (SPLINTS system).

As mentioned in Chapter 3 (Section 3.5.4), reflexive thematic analysis using Braun and Clarke's (2006) six-step process to identify themes was undertaken. This process is outlined in Table 6-1.

Table 6-1: Reflexive thematic analysis process

Step one: Familiarisation with the data
This involved watching the audio/video recordings of the twelve scenarios (Groups 1-4, Manikin scenario, Groups 1-4 Human SP scenario and Groups 1-4 Paper-case) prior to transcribing any data. Active listening was used to develop an understanding of what occurred in each scenario. No formal notes were taken at this stage, only notes relating to mannerisms, gestures, and positioning of learners in the rooms. Following this, written transcripts of each recording were then created using a standardised format (Appendix M). When complete, transcripts were read numerous times.
Step two: Generating initial codes
Sections of the transcripts were highlighted and labelled (coded) to describe their content. Everything that stood out as relevant or potentially interesting in each transcript from every scenario was highlighted. Sections were colour-coded using highlighters to emphasise all the phrases and sentences that matched the codes. Any new codes were added throughout the transcripts. Codes were then gathered, tabulated and number of instances counted, prior to generating word clouds (Appendix N) to aid the visualisation of key words. Codes were associated to Bandura’s Social Learning Theory (Environmental, Personal and Behavioural factors). An initial mind map was also produced (Appendix N) suggesting Prompting, Positive experiences, Negative experiences, and Gathering information as key to all three scenarios.
Step three: Searching for themes
Codes were then reviewed, revisited, and assembled into initial suggested themes linked to the SPLINTS categories. At this point, the themes were loosely: Uncertainty/confusion, Gathering information, Recognising and responding to cues, Verbal and non-verbal communication skills and Overcoming difficulties.
Step four: Reviewing themes
An interim mind-map was created to order thoughts (Appendix N). Themes were generated using a reflexive inductive approach to generate meaning from the codes. A clearer picture of the themes and sub-theme structure was becoming apparent. Each initial theme was separated according to whether it was associated with Environmental, Personal or Behavioural factors, and subsequently, using a deductive approach, linked to the SPLINTS categories: Situational Awareness, Communication and Teamworking or Task Management category. All changes were tracked and documented.
Step five: Defining and naming themes
Six common themes were finalised and named so that the names made sense to a reader. For example, the initial theme Uncertainty/confusion was named ‘Uncertainty in the learning environment’ with sub-themes of ‘Confusion’ and ‘Miscommunication’. The six themes were: 1. Knowing how and when to raise concerns 2. Understanding patient needs 3. Verbal and non-verbal communication 4. Uncertainty in the learning environment 5. Patient safety 6. Engagement with the scenario Seventeen subthemes were also extracted from the codes. Themes and sub-themes are illustrated in Figures 6-1 and 6-2.

Step six: Producing the report
The order in which themes should be reported was decided to create a logical and meaningful explanation of the qualitative data. The transcripts were re-visited to select data extracts, which were used to illustrate the themes and sub-themes. Each of the six themes and seventeen sub-themes were discussed in detail. Brief excerpts were included in Chapter six and created a narrative, which highlights the learner's voice, experiences, and insight into the scenarios they experienced. Rather than merely presenting the findings, analysis of the themes was interwoven into Chapter 6, creating an analytical discussion, which was then integrated and synthesised with findings from the quantitative data in the final Discussion of the findings (Chapter 7).

The reflexive thematic analysis process undertaken is illustrated in Appendix N.

Within the three scenarios, there were six separate themes, which were associated with the three SPLINTS Categories transferred from the structured observational methods. These six themes, aligned to Bandura's Social Learning Theory (SLT) and relate to behavioural factors, personal factors, and environmental factors (Bandura, 1977a). The six themes discovered from the transcribed data were grouped and related specifically to the three preconceived SPLINTS system Categories: Situational Awareness, Communication and Teamworking, and Task Management. The six themes that were induced from the transcribed data were: Knowing how and when to raise concerns; Understanding patient's needs; Verbal and non-verbal communication; Uncertainty in the learning environment; Patient safety; and Engagement with the scenarios. These themes are illustrated in Figure 6-1.

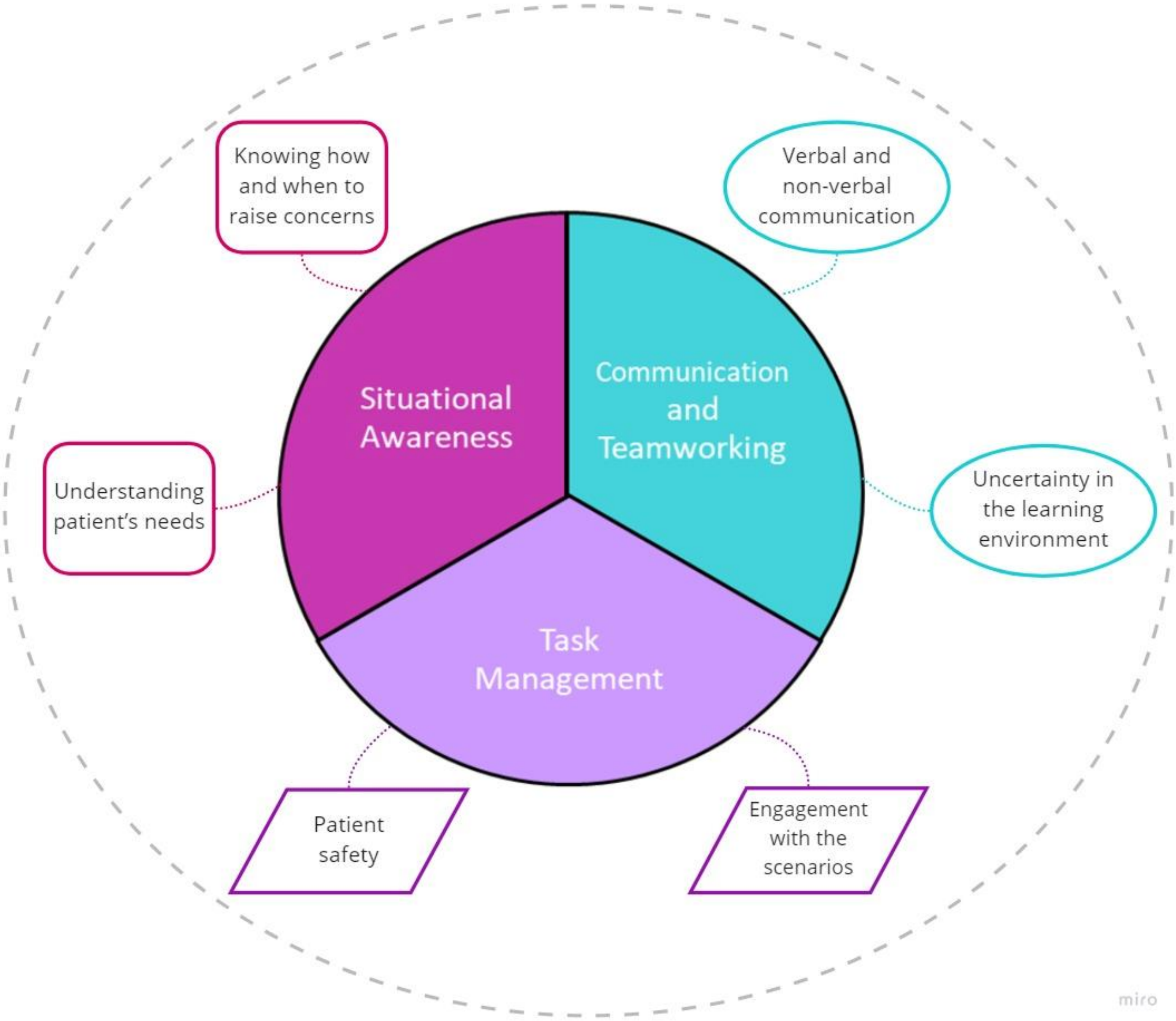


Figure 6-1: Common themes linked to SPLINTS system categories.

Each of the six common themes had associated subthemes, which were induced and defined from the coded data. These are listed below and illustrated in Figure 6-2.

Category 1: Situational Awareness

- **Theme 1: Knowing how and when to raise concerns**

  Subthemes:

  - Urgency
  - Recognising own limitations and the need for a multi-disciplinary team
  - Safeguarding

- **Theme 2: Understanding patient's needs**

  Subthemes:

  - Recognising patient's condition
  - Realism
  - Recognising and responding to environmental cues

Category 2: Communication and Teamworking:

- **Theme 3: Verbal and non-verbal communication**

  Subthemes:

  - Use of language/silence
  - Expressive touch
  - Consent, privacy, and dignity
  - Recognising and responding to verbal cues

- **Theme 4: Uncertainty in the learning environment**

  Subthemes:

  - Confusion
  - Miscommunication

Category 3: Task Management

- **Theme 5: Patient safety**

  Subthemes:

  - Moving and handling
  - Risk assessment
  - Overcoming difficulties

- **Theme 6: Engagement with the scenarios**

  Subthemes:

  - Support from a facilitator
  - Gathering information

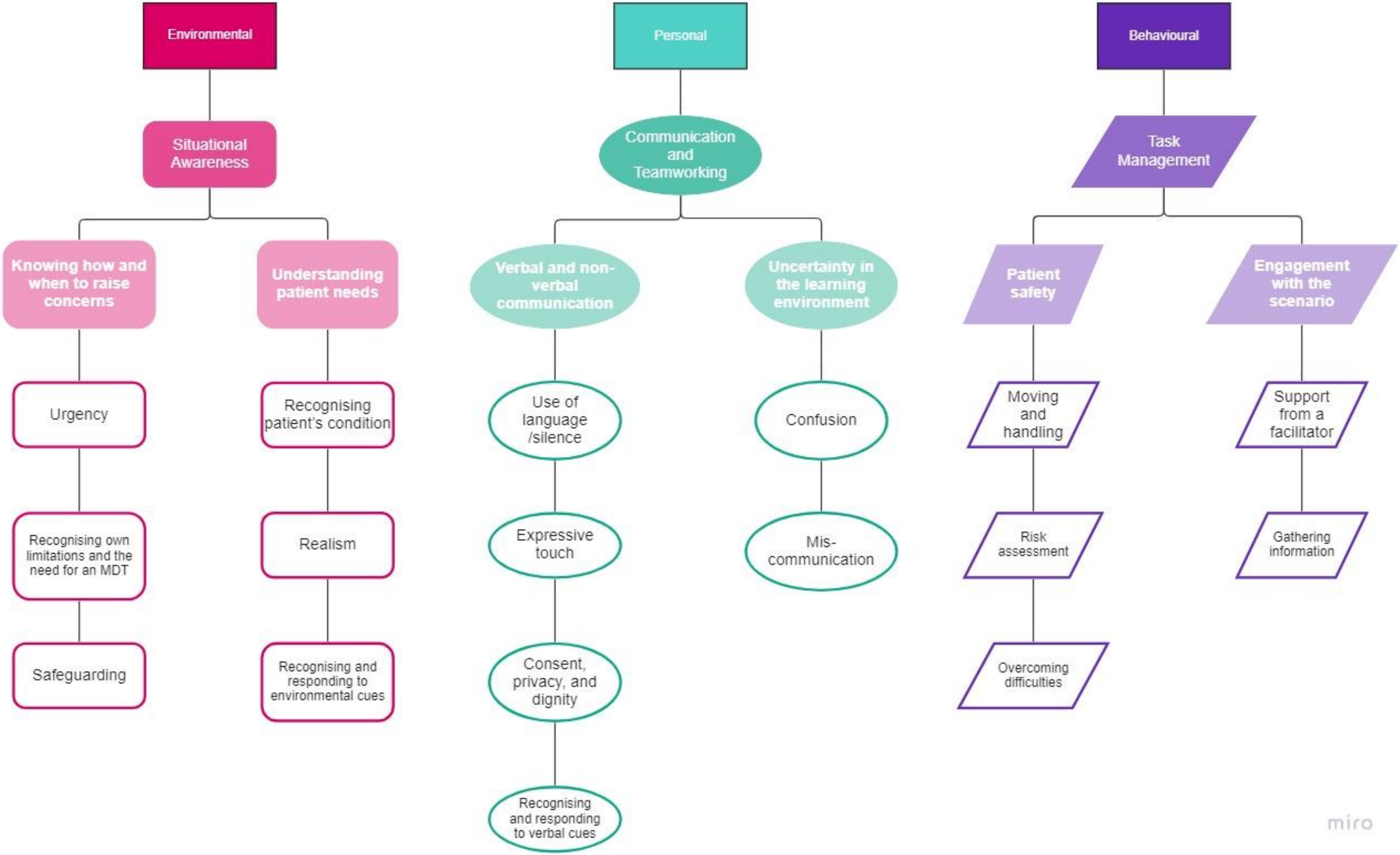
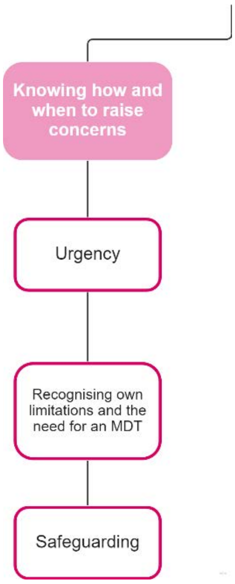


Figure 6-2: Six common themes and seventeen subthemes extracted from the data, aligned to Bandura's (1977a) SLT

A sample of transcripts can be found in Appendix M. Common themes and sub-themes will be described in detail in the following sections, with selected sequences from the original transcripts included, to illustrate each theme.

Category 1: Situational Awareness

6.2.1 Theme 1: Knowing how and when to raise concerns



During each of the scenarios, learners gathered information, processed this information, and anticipated how the scenarios were going to develop and progress. In response to their situational awareness, learners raised concerns about different elements of the scenarios they were engaged in. The concerns related to their own ability to carry out certain tasks or aspects of the scenarios, safeguarding concerns and, in some cases, the urgency with which they should act.

6.2.1.1 Subtheme: Urgency

During the Manikin scenario, half of the groups recognised that the patient was deteriorating following their assessment and made an urgent telephone call to request assistance from paramedics. The urgency was apparent in their tone of voice and the language they used while explaining to Levi and his daughter that he would need to be transferred to hospital and during the telephone calls to the Emergency Services call handler:

Manikin scenario	
Learner 1: [on phone] hi there we have an unwell gentleman…	
Learner 1: [on phone] his oxygen saturations are dropping, around eighty seven at the moment	(Group 1)
Learner 2: [goes to make a phone call]…	
Learner 2: [on the phone, off camera] can I have an ambulance please?	(Group 3)

These learners had noticed the patient's deterioration and recognised that they needed assistance from other healthcare professionals immediately. Group 1 used the phrase 'an unwell gentleman' and provided further explanation to the call handler to emphasise their point, that his oxygen saturations were decreasing. Group 3 firmly stated that they required an ambulance. Learners in both of these groups recognised that they could not provide adequate care for Levi themselves within his home environment and that he would need hospital care urgently and they relayed this information to Levi and his daughter in a professional manner:

Manikin scenario
Learner 2: I think it's best off if we call an ambulance and get your dad
Hollie: [shocked] What?
Learner 2: get him taken into hospital…
Learner 1: he's going to need some oxygen, so it's the only real option (Group 1)

Urgency was also evident during the Human SP scenario, where all four groups recognised the urgency of the patient's objective to get up and out of bed for the first time following a long period of time sedated in bed attached to a ventilator, which was helping his lungs to breathe. These learners also recognised the patient's desire to return to his previous level of physical ability:

Human SP scenario
Levi: well, er, it's just that I'd like to think about, you know, doing more, you know what I mean, I wanna get back to being healthy and
Learner 1: yeah, yeah
Levi: I want to go home really (Group 1)

Learner 1: yeah, that's right. So we know you've had you've had quite a long stay in hospital haven't you so far
Levi: yeah, too long, I want to go home really
Learner 1: yeah, so that's why we want to get you up and moving (Group 2)

In response to Levi's requests to get up out of bed, three of the groups were observed to assist him out of bed, so he was sitting in a chair, while one group of learners moved Levi, so he was in a seated position on the side of the bed. Patient management and rehabilitation was the main scenario learning outcome: *Apply unit content to develop and justify the management and rehabilitation of patients with critical illness*. All four groups achieved this outcome by assisting Levi so that he was sat up, ready to commence the rehabilitation process.

During the Paper-case, all four groups raised concerns and responded to the scenario information presented. Some of the learners treated the scenario as a realistic patient case, despite the information being presented via paper. This 'buy-in' and concern was apparent in all four groups due to their response to a visual prompt; an image of Levi's bruised wrists and the implication that he'd been hurt. Some groups queried whether he was being subjected to domestic violence and all four groups mentioned the need for an urgent safeguarding referral, along with additional support and training for his wife, Alana:

Paper-case

Learner 1: okay [reads the paper case] some bruises on his wrist, ohhh, oh dear, (Group 1)

Learner 1: so, he is at risk of harm isn't he
Learner 2: yeah… (Group 2)

Learner 2: …we've got a duty of care to both those people (Group 2)

Learner 2: do you think she's dragging him up? (Group 3)

Learner 1: How did he get hurt?...
Learner 3: safeguarding vulnerable adults, he's, we have to, she doesn't mean to, I think they were kind of, they got into a fight or something like that (Group 4)

The extracts above demonstrate the discussion learners from all four groups engaged in, related to Levi's risk of harm. Learners also queried how and why he may have been hurt, and how the bruises may have occurred. The urgency was apparent in the learner's tone of voice and the language they used to communicate their concerns, for example 'ohhh, oh dear'. Learners in all three scenarios recognised the time constraints and urgency to complete the scenario learning outcomes in the allocated time frame, which was twenty minutes for each of the scenarios.

6.2.1.2 Subtheme: Recognising own limitations and the need for a multi-disciplinary team

In the Manikin scenario, learners were heard voicing their concerns for Levi, but, at the same time recognising their own limitations and need for a multidisciplinary team (MDT) approach. In response to this recognition of their own abilities, they discussed the need for referral to other healthcare professionals including the General Practitioner (GP), speech and language therapists and paramedics:

Manikin scenario

Learner 1: has your GP been out Levi? (Group 1)

Learner 1: Have you seen some salt, erm, speech and language, have they been to see you? (Group 2)

Learner 2: and when we get back to the office, we could have a chat to the speech and language therapists to see if they could help and come out and just assess you Levi for if you are drinking fluids and things (Group 2)

As mentioned in Subtheme: Urgency, half of the groups called directly to 999 for assistance from paramedics. However, the quotes above demonstrate that learners understood that they alone could not manage to care for Levi at home without assistance. They all recognised their own limitations and suggested that they required assistance from other healthcare professionals. Group 1 also acknowledged that they could not prescribe medications for Levi and Group 3 recognised that they were unable to provide him with oxygen, should he require oxygen therapy:

Manikin scenario

Levi: no, I don't want to go to hospital, I want to stay here

Learner 2: I know but the problem is, we're from Physio Levi, so we haven't got any kind of access to medications or anything (Group 1)

Learner 1: [to Levi] we just need to have them assess you as well, they have oxygen available as well should you need that oxygen (Group 3)

The Paper-case also enabled the learners to recognise their own limitations and the need for an MDT approach, including making appropriate referrals to social services, home carers, psychologists, counsellors, speech and language therapists, and other healthcare professionals:

Paper-case

Learner 2: well wouldn't, would that not be social services? (Group 1)

Learner 2: …the need for carers, he's not got carers has he? (Group 2)

Learner 2: …and make appropriate referrals, because it wouldn't be physios necessarily always that would organise that (Group 2)

Learner 3: so it's social services that would be involved

Learner 2: yeah

Learner 3: safeguarding, informing the appropriate social services…just put informing the appropriate agency about the incident (Group 4)

During the paper case, learners recognised that they would need assistance from others to support them and manage the situation. This was again related to the scenario main learning outcome: *Develop, justify, and apply management strategies for specific patients in real-time in simulated situations*. They also recognised that the referrals were necessary and varied, depending on the patient and relative's needs, in particular, recognising their own limitations in areas such as safeguarding and mental health support. One group suggested the tools they would use to assess the patient's and carer's mental health and another group suggested they would need to make a referral to a psychologist or counsellor:

Paper-case

Learner 1: okay. Do you know about any risk assessment or risk rating tools that we can use here? [pause] and consider Alana's mental health and risk assessment, so can we just like refer her to some psychologist

Learner 2: yeah like a…

Learner 1: psychiatrist?

Learner 3: no

Learner 1: we can basically talk to her

Learner 3: we can talk, we can do counselling

Learner 2: counselling

Learner 3: when you inform the appropriate agency, they know what to do (Group 4)

Learners in all three scenarios managed the situations that were presented to them to the best of their abilities; they recognised their own limitations, which can often be challenging for pre-registration students due to their lack of experience and should be commended. Whilst they did not always know *how* to raise their concerns, they understood that they alone could not manage the scenarios and they required additional help and support.

6.2.1.3 Subtheme: Safeguarding

Safeguarding is the process related to protecting a person's health, wellbeing, and human rights, which will enable them to live free from harm, abuse, and neglect (NHS England, 2023). Safeguarding concerns were apparent in all three scenarios. During the Manikin scenario, learners were required to recognise the patient's deterioration and inability to remain free from harm at home without additional support. During the Human SP scenario learners were required to protect Levi's health and wellbeing by enabling him to achieve a quick and safe discharge home.

Safeguarding was also a key element of the Paper-case. During Part 2 of the Paper-case, the learners were presented with an image of Levi's bruised wrist and text stating *Alana is* *struggling* and *She doesn't mean to hurt him* (Community Scenario C, Appendix K). All four groups recognised this visual cue and discussed whether Levi was at risk of serious harm. Some learners suggested assessment tools they may use to measure the risk, they discussed safeguarding policy and process, and their own training needs. Most learners, however, were unsure of the correct process and protocol for carrying out a safeguarding referral:

Paper-case

Learner 1: yep, yep, yep [pause] I have no idea how safeguarding works in the community
Learner 2: I do
Learner 1: so that would be a training need (Group 2)

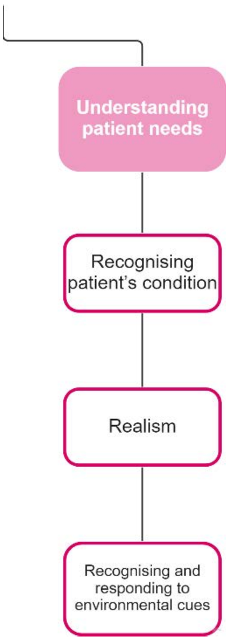
Learner 1: so you'd want advice on like, erm, safeguarding
Learner 2: like do you need to report it at all? I don't know if you're meant to speak to them or not, like approach them (Group 3)

Learner 1: yeah
Learner 3: so…
Learner 2: basically, anything that while examining you came across this and you ask the patient and he said, you know, this is a domestic issue in the home
Learner 3: so you have to do safeguarding because he's a vulnerable adult, you have to inform the, erm, appropriate, erm, yeah, we have to inform the appropriate bodies, is it bodies, or appropriate, erm, section for safeguarding. So it's social services that would be involved
Learner 2: yeah
Learner 3: safeguarding, informing the appropriate social services…just put informing the appropriate agency about the incident because it's the responsibility of every health professional to look out for things like that *(Group 4)*

Learners were observed to have limited knowledge of safeguarding procedures; one learner stated that they did not know the correct process for safeguarding referral in the community, while another learner suggested they had identified a personal training need in this area. The learners did, however, recognise safeguarding referral was important in this case, and one group stated it was all healthcare professional's responsibility to take notice of any signs of abuse and neglect, to protect patients' health and wellbeing. It was apparent, from the learner's behaviours, that they were finding this part of the Paper-case particularly difficult. Learners drummed their fingers on the table, put their heads down, their communication was disjointed, and they used hesitation in speech, for example, the terms 'erm' and 'er'. This hesitation and uncomfortable behaviours could perhaps have been alleviated if there was facilitator present to step in and provide answers to their questions.

Overall, Theme 1: Knowing how and when to raise concerns, has covered information regarding learner's ability to raise concerns, the urgency with which they raised their concerns, recognition of their own ability to proceed with the scenarios, acknowledgement of their own limitations and the need for additional assistance from other healthcare professionals and finally, safeguarding concerns that were revealed and were related specifically to Levi and the three scenarios in which they engaged with him. The next Theme will explore the learner's ability to recognise and understand the patient's needs.

6.2.2 Theme 2: Understanding patient's needs



During the three scenarios, learners were required to gather data, recognise cues, and anticipate whether the patient was deteriorating, at risk of harm or well enough to proceed with assessment and treatment. Learners were expected to carry out the scenarios within their scope as pre-registration Physiotherapy students. Every learner gained an understanding of Levi's needs; they recognised the different conditions that were presented and, using situational awareness, responded to various environmental cues. However, they also experienced limitations related to the realism of the scenarios. All of these areas will be discussed under the next three subthemes.

6.2.2.1 Subtheme: Recognising patient's condition

During the Manikin scenario, half of the groups (2/4) recognised Levi's deterioration and the need to escalate urgently. Learners applied their preceding theoretical knowledge, which enabled them to recognise changes in the patient's physiological observations, for example, his elevated temperature and decreased oxygen saturation. As discussed under Theme 1, learners in these groups recognised that they needed additional assistance from other healthcare professionals as they were not able to effectively care for Levi at home. They also noted that he would need further examinations, a chest x-ray, oxygen therapy and medications:

Manikin scenario

Learner 2: we we've checked his, what we go off, we go off kind of criteria, certain things and he's got quite a high temperature, his oxygen saturations, there's just a few things that have added up and we'd rather he got checked over, and they can give him a chest Xray
Levi: I wanna stay here
Learner 1: he's going to need some oxygen, so it's the only real option (Group 1)

Hollie: right
Levi: [cough cough]
Learner 2: but I think because he needs a fairly urgent review because of his markers, I think we are going to ring 999 as well (Group 3)

The other two groups did not recognise the seriousness of Levi's deteriorating condition. These groups chose to leave the patient at home, rather than calling for immediate assistance from paramedics, which could have resulted in serious further deterioration in the patient's condition:

Manikin scenario

Learner 1: and hopefully with you doing those nice deep breaths and then you doing some of that coughing and you might be getting some of that stuff up off your chest mightn't you. And that might make your breathing a bit more easy

Levi: [coughing] (Group 2)

These learners were aware that Levi did not want to be admitted to hospital, so they attempted to keep him at home by carrying out breathing exercises to aid his breathing. They also suggested that they would make additional referrals to Levi's GP and speech and language therapists. The groups that did not refer urgently to secondary care services, may not have recognised Levi's deterioration due to lack of situational awareness, knowledge or skill deficit, or an inability to carry out tasks associated with the scenario due to other emotional factors, such as fear or lack of interest, which will be revealed from the quantitative data analysis.

Most of the groups during the Manikin scenario demonstrated a systematic, structured approach to their assessment of the patient:

Manikin scenario

Learner 2: yeah, so, if we were going through A-E, airway, [to Levi] Levi, are you still with us?

Levi: yeah (Group 3)

The above group referred to the commonly used A-E assessment approach, which covers assessment of a patient's Airway, Breathing, Circulation, Disability and Exposure (Critical Care Skills Institute, 2003; Resuscitation Council UK, 2023). Other groups were observed to use the NEWS chart as a prompt to remind them of the physiological observations they needed to carry out.

Learners in all four groups used acceptable and appropriate technical skills. Despite the patient being a manikin, learners maintained a patient-centred approach. They used appropriate techniques to re-position Levi in an attempt to assist his breathing, and they used clinical skills to assess whether their interventions had improved Levi's condition:

Manikin scenario

Learner 2: can I go up a little bit further? [raises head of bed]

Levi: yeah [weak coughing]

Learner 2: okay

Levi: yeah

Learner 2: [to Learner 1] already looks a bit better actually

Learner 2: [to Levi] your breathing already looks a bit better in this position Levi (Group 2)

Learner 2: [to learner 1] his saturations are quite low, so I don't know if we're going to have to think about positioning him

Learner 1: yes

Learner 2: I'm just going to have a listen to your chest again Levi, okay? (Group 3)

Learner 2: check the symmetry of the chest movements (Group 4)

In contrast to recognising patient deterioration, during the Human SP scenario, learners were required to recognise that Levi's condition had improved since the previous scenario when he was at home. In the Human SP scenario, learners assessed Levi in hospital, following a period of time where he had been sedated and attached to a ventilator. All of the learners used clinical skills to assess Levi's physiological observations and clinical judgement when checking his chart for previously recorded observations. They recognised that Levi's condition had improved, and found that he was able to engage with some rehabilitation activities post-ventilation:

Human SP scenario

Learner 1: put that on your finger [monitor beeps]

Learner 1: that's brill. Shall we do blood pressure at the same time? When was it last done?

(Group 1)

Learner 1: well, this says that your breathing looks okay, it says that your oxygen levels are doing okay. Your blood pressures a little bit on the low side, but nothing that we wouldn't expect from being in bed so long. (Group 4)

Learners in the Human SP scenario proceeded with the objective to manage and rehabilitate Levi based on the improved condition that was presented.

Learners were challenged by the Paper-case and expressed concern for the patient's welfare and his wife, Alana's, mental health. All four groups worked effectively to interpret the case, and comprehend elements associated with Levi's physiological observations and condition:

Paper-case

Learner 1: so, there's nothing really that particularly concerns me about his vital signs

Learner 2: no

Learner 1: or his breathing, erm, sounds like his pupils are fine as well, looks like it's mostly his tone isn't it, skin pale, could possibly be dehydrated or something like that. I wouldn't think he's like got an infection or anything like that (Group 1)

Learner 1: yes, so now we will monitor all the vitals

Learner 2: okay (Group 4)

During the Paper-case learners discussed Levi's vital signs, his breathing, temperature, skin colour, mobility, level of hydration and pupil size. They related the information presented in the Paper-case to Levi's condition and the actions and management strategy they would develop, justify, undertake, and applied this information to the case.

Learners also drew conclusions from the Paper-case data, which assisted in their development of an action plan for Levi's assessment and care:

Paper-case

Learner 2: can you speak to them like both together and get like a, you know, have a discussion with them both regarding what they feel they need kind of thing?
Learner 1: yeah yeah (Group 1)

Learner 2: just a different, you know, even if it's accidental, it's still, you know, she needs additional support needed (Group 1)

Learner 2: maybe we'll do a chest assessment?
Learner 1: yeah or maybe we'd reposition him? (Group 4)

Learner 1: okay. Do you know about any risk assessment or risk rating tools that we can use here? [pause] and consider Alana's mental health and risk assessment, so can we just like refer her to some psychologist (Group 4)

The extracts above demonstrate the type of discussions that took place, which involved communication, re-education, and training for the patient and his wife, risk assessment, suggestions for additional support that they may require, assessment tools they would use to assess the patient and his wife, plus referrals to other health professionals they would action. Although the learners did not physically demonstrate any technical skills during the Paper-case, they discussed, in detail, the physical skills and actions they would carry out in the scenario. These actions included, for example, washing their hands, putting on PPE, chair and bed exercises, moving and handling of the patient, patient strength assessment, exploring mechanisms of injury, assessing patient transfer, assessing physiological observations, repositioning, and respiratory assessment.

In each of the three scenarios, learners used their knowledge and skills to demonstrate how they would assess, recognise, and respond effectively to the patient's condition that was presented.

6.2.2.2 Subtheme: Realism

Learners experienced some limitations during the scenarios related to the realism of equipment and the environment. As discussed previously, realism is the ability of learners to suspend disbelief by creating an environment that replicates that of the learner's work environment (Lioce et al., 2020). Realism relates to the environment, simulated patient, and activities of the facilitators. The term *environment* in this definition refers to the manikin, room, equipment, moulage, and props (Lioce et al., 2020). In the Manikin scenario, the room was a simulated home environment, and the equipment included a high-tech manikin patient with related patient monitors. Learners sometimes found it difficult to accept the manikin as a real patient. For example, there was one exchange where the learners discussed the mechanical noises or 'clicks' from the manikin, which caused an obstacle for the learners during assessment of the patient's breathing and physiological observations. Learners also mentioned that they could not feel a pulse on the manikin, and some were observed to be struggling to use certain pieces of equipment:

Manikin scenario

Learner 1: [places hands on manikin] I'll have a feel here, see if there's any at the top here. That's alright isn't it?

Learner 2: [to Learner 1] you know where it clicks on the right, I think that's just the…[trails off] (Group 2)

Learner 3: is that okay? Yeah [to other Learners] I don't know how to work this [fiddling with equipment] (Group 3)

Learner 3: [to Learner 2] could you feel pulse?

Learner 2: I couldn't (Group 4)

This affected the learner's ability to suspend disbelief; they were unable to discern between the noises they were supposed to hear versus the mechanical sounds of the manikin when undertaking a chest assessment. This, in addition to their inability to feel a pulse and use equipment effectively, may have impacted on their capacity to meet the scenario learning outcomes. Despite this, at the end of the Manikin scenario learners in Group 1 were heard to state that they had found it 'surreal' and realistic:

Manikin scenario

Learner 1: Oh, that's finished. That felt so surreal

Learner 2: I know, that was strange. I feel like I've had a real patient and I went to their house (Group 1)

Realism during the Manikin scenario should be considered in comparison to the Human SP scenario. During the Human SP scenario, the patient was a human in role acting as Levi and therefore, undoubtably more realistic. However, suspension of disbelief was expressed by one group within the learning environment, not regarding the patient, specifically, but related to their own behaviours. In this example, a learner broke from their role and asked the facilitator whether they should 'pretend' that they had a piece of equipment. This could have meant that the learners felt unable to engage as realistically with the scenario as they would do, had they been in actual clinical practice:

Human SP scenario

Learner 1: I would probably use a Zimmer frame first time, shall we pretend we've got one?

Nurse: no, I'll get one

Learner 1: oh thank you

Nurse: erm, give me two minutes (Group 4)

This issue depicted above was quickly rectified by the embedded facilitator, who left the room to retrieve a Zimmer frame that was required, therefore enabling the learners to quickly get back into role and continue with the scenario.

Realism in the Paper-case was not voiced by any of the groups, however, through the observations it appeared that learners were able to 'buy-in' to the scenario, despite it being presented via written text and images. This could have been due to the fact that the learners had had a comprehensive introduction to the patient, his family members, and his personal situation via digital media (Chapter 4, Section 4.6.1). Learners were introduced to Levi via a video, which depicted him at home; they gained insight into Levi's personal characteristics, his likes, and dislikes. They also met Levi as a manikin and a human SP in the two previous scenarios, which may have enabled the learners to fully immerse themselves in the Paper-case. This will be explored further in Theme 6: Engagement with the scenarios.

6.2.2.3 Subtheme: Recognising and responding to environmental cues

During all three scenarios, the learners received and responded to environmental cues. These cues were delivered and received in different ways, to enable the learners to proceed through the scenarios and achieve the desired learning outcomes. During the Manikin scenario, for example, patient observations, available via the patient monitor, gave environmental cues that Levi's condition was deteriorating. This deterioration, when noted, enabled learners to respond to his needs during the scenario:

Manikin scenario

Learner 3: [whispers] is there a clock?

Learner 1: [whispers and nods at the clock on the wall] yeah just there. It's not on there is it? [looks at patient monitor] oh yes it is it's…[incoherent]

Learner 3: [picks up patient monitor] (Group 3)

Learner 2: [to Learner 1 and 3] so under A, he's talking to us, so he's got an airway, we know his oxygen is low, erm, obviously we haven't got any oxygen here. B, [points at patient monitor] resp rate is high

Learner 1: yeah it's high (Group 3)

Here, learners interacted with the patient monitor, they pointed out key changes in the patient's condition that were displayed on the monitor and responded to these cues by noting the observations on a chart, carrying out an assessment, and drawing conclusions about his condition.

Learners also responded to the presentation of personal data such as physical findings from the manikin, for example, respiration rate (the number breaths per minute), heart rate (the number of heart beats per minute), chest sounds, pupil size and respiratory assessment. All of these parameters were shown by the manikin for the learners to explore and discover:

Manikin scenario

Learner 1: shall we do a few together now while we're here? Should we? So I'm going to put my hands back on where they were, so you can feel that we're doing nice deep breaths [places hands on Levi's chest], okay, so you take a nice deep breath with me, that's it, well done. And out, good (Group 2)

The extract above demonstrates learners communicating to Levi about how they were going to carry out a breathing assessment and monitor him during the Manikin scenario.

In the same way, throughout the Human SP scenario, the patient monitor and patient notes on the bedside table, acted as environmental cues that prompted the learners to appraise whether Levi was well enough to progress with their assessment and treatment:

Human SP scenario

Learner 1: [walks to foot of the bed] can I have a look at your notes then Levi, are these all your bits and bobs here? (Group 1)

Learner 1: okay [walks to foot of the bed to look at chart with Learner 3] (Group 2)

Learner 1 and 2: [move to end of bed to view Levi's chart]
Levi: does everything look alright on there to you?
Learner 1: well, let's see (Group 4)

In the above excerpts we see the learners discussing the patient notes, which they interacted with, and, using their skills of clinical reasoning, identified trends in Levi's condition. Once they had reasoned that Levi's condition had improved and he was well enough to engage with treatment, they proceeded with their assessment.

The Paper-case itself gave visual cues to learners, these included photographs and text. Using situational awareness, the learners were able to observe what was taking place in the Paper-case and respond appropriately to the cues. In all scenarios, learners recognised environmental cues, acknowledged, and responded to them. Some groups took longer than others to interpret the data, but with additional prompting, the required outcomes were achieved.

When learners were unsure in the Manikin and Human SP scenarios, they sought help from the embedded facilitator. However, there was no facilitator in the Paper-case, so the learners relied on other team-members for assistance. The following extracts show examples of learners in Groups 1 and 2 working together to recognise and respond to environmental cues during the Paper-case:

Paper-case

Learner 1: yeah. Okay, what equipment do we have?

Cue - *Learner 2: erm, blood pressure cuff, sats monitor*

Cue - *Learner 1: erm yeah [flicks through and reads from paper case] gloves, aprons, stethoscope, thermometer, slide sheet, okay, right*

Response - *Learner 2: shall I put, put on PPE?*

Response - *Learner 1: yeah yeah* (Group 1)

Cue – Image of Levi's bruised wrists

Response - *Learner 1: okay [reads the paper case] some bruises on his wrist, ohhh, oh dear, so now we're looking at, erm, safeguarding aren't we*

Learner 2: *yeah, so refer to safeguarding [writes on paper case], refer to social services*

(Group 1)

Cue - Image of Levi's bruised wrists

Response - *Learner 1: oh gosh, right*

Response - *Learner 2: oh God, I didn't expect domestic violence, is it something like domestic violence?*

Learner 1: no, she's just, she's manual handling

Learner 2: oh right, okay

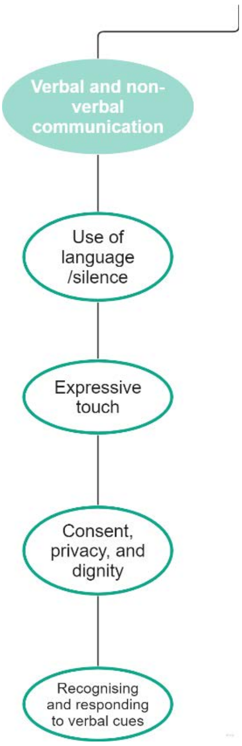
Learner 1: she's pulling him up?

Learner 2: definitely? [pause] I'd still query it though (Group 2)

Environmental cues played an important role in all three scenarios; cues are necessary to prompt learners to think, respond, and achieve the learning outcomes. They are used to push the scenario through to its conclusion and to provide reassurance or clarity during simulation-based education. Environmental cues can be presented in many ways including, visual, written, and physiological cues. During the Paper-case, as no facilitator was present to communicate verbal prompts, the learners relied on their own theoretical and clinical knowledge, plus situational awareness and the written and visual cues presented in the Paper-case. Even so, there appeared to be a need for further support during the Paper-case as some learners were observed to be struggling to make sense of some of the information included. This will be discussed further in relation to Theme 4, Uncertainty in the learning environment and Theme 6, Engagement with the scenarios.

Category 2: Communication and Teamworking:

6.2.3 Theme 3: Verbal and non-verbal communication



Communication and teamworking enabled the learners to overcome boundaries in each of the scenarios; recurrent in all three scenarios was a keen sense of teamwork and the patient being at the heart of the scenarios. This theme will explore the learner's behaviours, their use of language, how and when they used expressive touch, their style of communication with the patient and other people embedded within the scenario in relation to consent, privacy, and dignity. It will also shed light on how learners recognised and responded to verbal cues.

6.2.3.1 Subtheme: Use of language/silence

In the Manikin and Human SP scenarios, learners used positive language skills to introduce themselves and communicate effectively with the patient, his daughter, and the nurse. Three of the groups introduced themselves to the patient in both the Manikin and Human SP scenario. Learners also explained themselves clearly to the patient in these scenarios. In all three scenarios, all learners showed examples of effective teamworking.

In the Manikin scenario specifically, there were good examples of decision-making, for example, when deciding on the best course of action for Levi based on their clinical findings. Learners used assertive language and behaviours to communicate to the patient and others. They also communicated effectively to escalate their concerns:

Manikin scenario

Learner 2: you're not going to get better just as you are, we need to get you some treatment (Group 1)

Learner 1: I appreciate that Levi, but I think it would be the best course of action for you, just to make sure that you're safe (Group 3)

Learner 2: but I think because he needs a fairly urgent review because of his markers, I think we are going to ring 999 as well (Group 3)

In the examples above, learners were observed using terms such as 'we need to', 'the best course of action', 'make sure you're safe' and 'he needs a fairly urgent review'. Using this persuasive language, the learners ensured they were fully understood. By asserting themselves in this way, they left no doubt about their intentions or requirements.

In contrast to the Manikin scenario, during the scenario with an embedded Human SP, the learners appeared more relaxed; they supported each other, laughed, and exchanged small talk and jokes with the Human SP:

Human SP scenario

Learner 1: oh, you're not one of those that takes your shoes off with the laces fastened, are you?

Learner 2: that's a bad habit of mine that as well Levi [laughing] (Group 1)

Learner 1: how's your dog Levi at home? Who's looking after it?

Levi: my wife's looking after it

Learner 1: aww, are you miss, what, is it a girl or a boy?

Levi: it's girl dog

Learner 1: what's she called?

Levi: Sadie

Learner 1: aww, are you missing her? (Group 2)

Learner 2: it's nicer to sit out isn't it for your meal

Levi: yeah

Learner 2: have you ordered anything good?

Levi: [sighs] well

Nurse: good?

All: [laughing]

Nurse: as good as it can be. We just have a few sneaky foods in

Learner 1: do you have take-aways?

Levi: mars bars [laughing] (Group 2)

Learners in the excerpts above showed examples of laughing and joking with the patient. They made quips about whether he had unfastened his shoelaces before taking off his shoes and joked about the quality of the hospital food. They also asked Levi about his personal life and whether he was missing his wife and his dog. This relaxed language and behaviours demonstrated that they were comfortable talking to the patient. Learners appeared calmer and more confident during the Human SP scenario, in comparison to the Manikin scenario and the Paper-case. This could have been attributed to the fact that Levi, in this case, was a human or it may have been that the patient's condition was stable, and, in the Manikin scenario, he was not well enough to engage in small talk.

There were also many examples of encouragement, positive reinforcement, and praise during the Human SP scenarios, which did not appear as overtly in the Manikin scenario or Paper-case:

Human SP scenario	
Learner 2: that's it, good [Levi moves left leg] good, well done, excellent	(Group 1)
Learner 1: very good	
Learner 1: this is brilliant	(Group 2)
Learner 1: go on, well done, that's it. And what about if you try with the other one?	(Group 4)

Learners used words like 'excellent', 'well done', 'very good', 'brilliant'. These positive communication skills served to reassure and encourage the patient. Learners also explained clearly to the Human SP what they wanted him to do:

Human SP scenario	
Levi: I'm falling over	
Learner 1: you're not falling, you're okay. So push yourself up from the bed	(Group 2)
Learner 3: keep going	
Learner 2: okay, step that right foot back. Okay, let's reach down to the arms of the chair. Okay, slowly sit yourself down	(Group 3)

Learners reassured and encouraged Levi, they gave some clear instructions to clarify what they wanted him to do, for example, to push himself up from the bed, or where to place his feet and hands and the speed with which they wanted him to move.

A difference that was apparent between the three scenarios was the amount of silence that was notable during the Paper-case, which was not present in the Manikin scenario or Human SP scenario. During the Paper-case, at the start, Group 1 read in silence for 2 minutes 45 seconds before discussing the scenario, Group 2 experienced nearly 3 minutes of silence throughout the scenario and Group 3 experienced seven separate moments of silence, totalling over 5 minutes. Since the Paper-case itself lasted twenty minutes, these moments of silence made up nearly one quarter of the time learners spent in the scenario. Group 4 read the Paper-case aloud to the group and, therefore, did not experience any moments of silence. In the Manikin scenario and Human SP scenario, learners were actively communicating with the patient, other learners, and embedded facilitators, who were all in role during the scenarios. The communication during all three scenarios was rich, the environments where the physical simulation scenarios (Manikin and Human SP) took place were busy and fast-paced, which was a clear difference in the Paper-case where, generally the learners were more thoughtful and quieter.

6.2.3.2 Subtheme: Expressive touch

In both physical simulation scenarios, learners used expressive touch to gently reassure the patient. Expressive touch conveys emotion, support, and compassion, for example, placing a reassuring hand on someone's shoulder. Expressive touch helps to develop therapeutic relationships with patients (Stonehouse, 2017) and lets them know you are there, and you care (Sharples, 2013). In the Manikin scenario, for example, learners rubbed Levi's chest and touched his shoulder:

Manikin scenario

Learner 2: [rubbing Levi's chest] tell me what you're feeling?

Levi: I'm not feeling well

Learner 1: [on phone] hi there we have an unwell gentleman…

Learner 2: [touching Levi's shoulder] Levi?

Learner 1: [on phone] his oxygen saturation are dropping, around eighty seven at the moment (Group 1)

During the Human SP scenario, there were also examples of expressive touch where a learner held Levi's hand and supported him:

Human SP scenario

Learner 2: …can I just hold your hand, is that alright? (Group 3)

Learners in the Human SP scenario also used expressive touch, more specifically in tactile communication[14] to reinforce their verbal instructions and actively encourage Levi to become more independent:

Human SP scenario

Learner 1: do you mind if I have a go? [reaches over to lift Levi's right leg up with both hands] so you're sliding that leg up. Is that a bit stiff?

Levi: yeah it's bit stiff

Learner 2: the other side [touching Levi's left leg gently]

Levi: a little bit, yeah

Learner 2: that's it, good [Levi moves left leg] good, well done, excellent (Group 1)

Learner 1: can you touch my hand with your knee?

Levi: [groans]

Learner 1 & 2: go on, push (Group 1)

Learner 3: can you bring it any further up? Touch my hand

Levi: touch your hand?

Learner 3: that's fine, okay, so I'm just going to go through the movement now [moves Levi's left foot backwards and forwards] that feels okay (Group 4)

These examples show how learners used touch to remind Levi of what they required him to do; they also touched, moved, and lifted his legs, which was appropriate considering this patient had been in bed on a ventilator for some time. This use of touch was coupled with verbal encouragement to 'go on, push', when encouraging him to move. Learners also praised Levi when he had achieved the desired outcome, which, in this case, was to move his legs prior to getting up out of bed. These examples show how important expressive touch can be in developing a therapeutic relationship and delivering care to a patient. Learners in the physical scenarios used touch to express comfort and compassion and to

[14] Tactile communication is communication that is done by touch, made to communicate without saying anything (N. Sam, 2013)

communicate without using words. However, learners were mindful of the patient's wishes in regard to touch and always gained consent, which will be described in the next subtheme.

6.2.3.3 Subtheme: Consent, privacy, and dignity

In the Manikin scenario, Human SP scenario and the Paper-case, learners discussed, implied, or directly asked for, consent from the patient prior to carrying out tasks. During the Manikin scenario, most groups implied or asked for consent:

Manikin scenario	
Learner 2: just breathe normally. Can I just undo your shirt slightly?	
Levi: yeah	(Group 1)
Learner 1: and how are your, er, can I have a look at your toes?	
Levi: yeah	(Group 2)
Learner 1: Levi am I okay to just to take your temperature?	
Levi: okay, yeah	(Group 3)

In these examples, learners used phrases such as 'can I', and 'am I okay to', when asking for consent. Furthermore, learners waited for permission from Levi prior to carrying out their tasks.

It is worth noting, however, that one of the groups regularly did not ask for consent during the Manikin scenario; this was an exception and was inconsistent with the majority of the data:

Manikin scenario

Levi: what are you doing?

Learner 2: we will just position you so that you'll feel a bit more comfortable

Learner 2: okay. [to Learners 1 and 3] so his SPO2

Levi: what you doing?

Learner 2: I'm so sorry, we are just checking your, erm, your saturation levels, but we just realised that...they are just checking the amount of oxygen that's…[trails off]

Learners 2 and 3: [mumbling together about Levi's position]

Learner 2: [to Levi] I'm just checking your pulse

Levi: what you doing?

Learner 2: I'm just positioning you low, so then you'll feel better

Levi: okay (Group 4)

The above examples demonstrate inconsistencies with Group 4, who were observed to tell Levi that they would position him and check his observations without asking for consent. They did not wait for agreement from the patient, prior to carrying out tasks, despite verbal cues from Levi, who was heard asking the learners what they were doing, which was a verbal prompt to remind them to ask for his consent. These learners failed to ask for Levi's consent, this could be because Levi was a manikin, or perhaps due to other personal factors related to verbal and non-verbal communication skills, cultural differences, or the learner's desire to react quickly to the patient's deteriorating condition with urgency, which may have pushed them to act with haste, rather than considering the patient's ability to consent.

During the paper-case, learners discussed asking for the patient's consent prior to proceeding with assessment and treatment:

Paper-case

Learner 1: yeah [writes on paper case] that it's ok to gain consent and proceed with physio assessment, yeah?

Learner 2: yeah (Group 2)

Learner 2: and you're gonna start treating him? Put consent (Group 3)

Although they were writing an action plan for this scenario, rather than physically carrying out the scenario, learners knew that it was important to gain permission prior to carrying out tasks.

Dignity and patient safety were apparent in the scenarios with a Manikin. During this scenario, some learners in Group 1 gathered Levi's belongings together, including his pyjamas and toiletries, prior to the ambulance arriving; here learners were considering the patient's comfort and needs:

Manikin scenario

Learner 1: [assertive] right Levi let's just get some of your bits together shall we, for the hospital. [to Hollie] so are we alright getting some erm pyjamas together erm

Hollie: good job we washed them

Learner 1: wash bag, lets get your toiletries and stuff as well, get your wash bag ready. Have you got a list of his medications? (Group 1)

Interestingly none of the learners in the Manikin scenario wore personal protective equipment (PPE) while assessing the manikin patient, even though PPE was available for them in the kitbag provided. In addition, none of the learners washed their hands or applied hand gel prior to engaging with Levi during the Manikin scenario. This contrasted with the Human SP scenario, where the majority of learners washed their hands prior to commencing the patient assessment. Furthermore, during the Human SP scenario, learners consistently considered Levi's safety, dignity, and privacy; they wore PPE, including gloves and aprons, prior to carrying out tasks and also confirmed Levi was wearing clothes prior to pulling back the bed covers:

Human SP scenario

Learner 1: I, we think so, don't we. Lets have a look at how you're getting on. Right, are you decent under there?

Levi: yeah (Group 1)

Learner 2: okay. Right, so, if it's aright with you, I'm going to pull the covers back. Have you got trousers on? (Group 3)

Learner 1: are we alright to take the covers back? Have you got trousers on? (Group 4)

Learner 2: in fact, we'll just wash our hands [Learners leave Levi's bed area to go wash hands at sink] (Group 3)

Here learners were observed asking the human SP if he 'was decent' and if he had trousers on. These differences in the subtheme of Consent, privacy and dignity could have been due to the differences in the environment, with the Manikin scenario set in a home environment and the Human SP scenario set in a hospital environment. Equally, it could have been due to other factors such as realism of the scenario or the learners failing to respond to verbal cues, which will be analysed in the next subtheme.

6.2.3.4 Subtheme: Recognising and responding to verbal cues

During the Manikin and Human SP scenarios, learners were presented with verbal cues, which were used a technique to elicit a response or action. Learners during the Paper-case provided verbal cues for each other and responded to these cues to progress the case.

The following extracts provide examples of learners receiving verbal cues from both the patient, Levi (manikin), and the patient's daughter, Hollie (embedded facilitator) during the Manikin scenario. Cues during this scenario were presented in two ways; as direct questions and as hints, with the intention of pushing the learners to respond or act:

Manikin scenario

Direct questions:

Levi: what you doing? (Group 1)

Hollie: he said it had gone down the wrong way, is that what aspiration is? (Group 1)

Levi: what's happening? (Group 4)

Levi: what are you doing? (Group 4)

Hints:

Levi: Oh, I don’t know, I’m not really feeling well (Group 1)

Hollie: [interjects from armchair – learners turn to face Hollie] he’s, you’ve not been well dad though since you had that cuppa tea (Group 1)

Levi: I’m not feeling well (Group 2)

Levi: I can’t breathe properly (Group 2)

Levi: no, no, I don’t feel cold. I don’t feel well though, really tired (Group 4)

The direct questions, for example, ‘what are you doing?’ often provoked verbal responses from the learners, whereas the hints like ‘I’m not feeling well’ or ‘I’m tired’ acted as prompts to encourage learners to act or respond.

During the scenario with a Human SP, verbal cues were delivered from the patient, Levi (human SP), and the nurse (embedded facilitator). Again, cues were in the form of direct questions and hints intended to push or guide the learners to respond, clarify, or act and to proceed quicker if the allocated time for the scenario was running out:

Human SP scenario	
Direct questions:	
Levi: is this what you want me to do?	(Group 1)
Nurse: are you actually getting him out, what what's your plan?	(Group 1)
Levi: do you want me to move it to the side?	(Group 2)
Levi: sorry, what do you want me to do?	(Group 2)
Levi: so, do you think you'll be able to get me out of bed then?	(Group 3)
Hints:	
Levi: I want to go home really	
Levi: like I say, really I wanna start thinking about getting home, because, you know, I miss my wife and my dog and stuff	(Group 1)
Levi: erm, I think I feel a lot better, you know, so hopefully I'll be able to get out of bed today	(Group 2)
Nurse: dinners are going to be coming literally in five minutes, so if we could get him up that's going to be just the perfect timing for you isn't it	(Group 2)
Nurse: [puts phone down] that was dinner, so we need to get you in that chair quick	(Group 3)

Overall, learners acknowledged and responded to these cues, however, in the Manikin scenario, one group (Group 4) did not introduce themselves despite repeated verbal cues from Levi:

Manikin scenario	
Levi: who are you sorry?	(Group 4)

Learners responded positively to verbal cues from the manikin and his daughter by providing explanations and using less technical language:

Manikin scenario

Cue - *Hollie: he said it had gone down the wrong way, is that what aspiration is?*

Response - *Learner 2: yeah so it's kind of gone down into his lungs, and that can obviously cause infections and things so…* (Group 1)

Cue - *Levi: I'm not feeling well*

Response - *Learner 1: how aren't you feeling well? What's, what's bothering you?* (Group 2)

Cue - *Levi: what are you doing?*

Response - *Learner 2: I'm putting this on your finger cos it's going to tell us how your oxygens measuring in your blood. It just tells us how your breathing is* (Group 3)

Cue - *Levi: [coughing] what's happening? What are you doing?*

Response - *Learner 2: he's just trying to check your pulse* (Group 4)

Learners in the above extracts were observed altering their behaviours and language to provide explanations, for example, to describe what aspiration was. They also responded to prompts by asking further probing questions about how the patient was feeling and by providing explanations to Levi, for example, when they were measuring his oxygen levels or checking his pulse. This additional information reassured the patient and allayed his concerns.

Learners also responded to verbal cues from the human SP and the nurse during the Humans SP scenario, which enabled the patient assessment and treatment to proceed:

Human SP scenario

Cue - *Nurse: he's raring to go, absolutely raring to go*

Response - *Learner 1: fab. Are we alright just to look at your chart and then we'll come and…* (Group 2)

Learner 1: *you see what you can do to bring your legs to the edge of the bed*

Cue - *Levi: I can't, the blankets are in the way*

Response - *Learner 1: [moves blankets] there we are. Okay, shall we try this one first?*

(Group 4)

The embedded facilitator (nurse) in the Human SP scenario also provided verbal cues to the SP, reminding them at one point, when he had forgotten a piece of information or said the wrong thing during the scenario:

Human SP scenario

Learner 2: so how what have you been up to in here, have you been out in the chair or anything?

Levi: no, I've been in the bed

Learner 2: in the bed

Nurse: ooh, you fibber, you big fibber, you have been out in the chair but by hoist [laughing]

Learner 2: so you don't feel like you've been on your feet but you've been sat out?

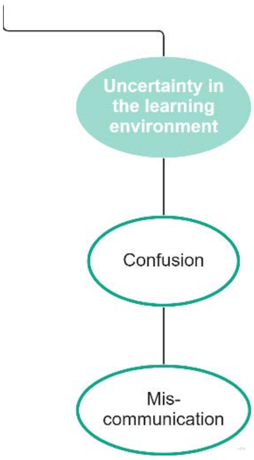
Levi: yeah (Group 2)

Here the SP stated that they had not been out of bed, but the nurse reminded him that he had in fact been hoisted into the chair. At this point, the SP smiled and realised the error. This was noteworthy as it prevented incorrect information from being transmitted the learners during the scenario.

There were no verbal cues presented during the Paper-case. However, learners received environmental cues from the Paper-case itself, these cues resulted in verbal responses from the learners, but the cues themselves were related to Situational Awareness.

Verbal cues played a key role in both the Manikin and Human SP scenarios; they prompted learners to react to the patient and embedded facilitators. They were used to correct errors and provide clarity during the scenarios. During the Paper-case, as no physical patient or facilitator were present to communicate verbal prompts, the learners relied on environmental cues and their own communication and teamworking skills to facilitate their own learning.

6.2.4 Theme 4: Uncertainty in the learning environment



There were a number of uncertainties that were induced from analysis of the transcripts. Both the learners and the patient were sometimes uncertain of what was required of them and how they should behave during the scenarios. This uncertainty led to confusion and communication breakdown.

6.2.4.1 Subtheme: Confusion

Confusion was common in all three scenarios, however, in the Manikin and Human SP scenarios, this confusion was allayed by quick interjection from the embedded facilitators. On the other hand, there was no facilitator present during the Paper-case, therefore, learners sometimes were unable to make sense of the scenario and became frustrated. Confusion can be divided into two areas: *acting confused*, related to the patient, and *being confused*, related to the learners.

During the Manikin and Human SP scenarios, the patient was often observed to be *acting confused* about what the learners required him to do. This was a deliberate cue to prompt the learners to explain themselves more clearly.

During the Paper-case, it was the learners who were observed *being confused*. This genuine confusion was as a result of the content of the Paper-case. They were sometimes unsure of what was required of them, but also about the subject matter of the scenario and did not know how to proceed to develop the patient's action plan:

Paper-case	
Learner 2: so what're we supposed to do?	(Group 1)
Learner 1: I don't know what else you'd ask them about	(Group 3)
Learner 2: does this mean we need to read these prompts too? And then have to write something	(Group 4)

Learners voiced their feelings, for example, using phrases like 'I don't know' and 'what are we supposed to do'. However, on the whole, they worked together using effective communication and teamworking skills to overcome these barriers and proceed with the Paper-case.

Learner's personal factors, for example, lack of confidence, inability to make decisions and clinical reasoning skills led to confusion, which was apparent during all three scenarios. During the Manikin scenario, learners lacked direction, reached for kit, then decided against it, changed their mind, there was also some mumbling, whispering, and huddling when learners gathered together to discuss their next actions:

Manikin scenario	
Learner 1: [reaches for kitbag then changes mind] Okay, so what do you want to do?	
Learners 2: so what would he be scoring?	*(Group 1)*
Learners 1 & 3: [huddled together whispering]	(Group 3)

In the next example, learners became confused and thought the patient *wanted* them to move his pillow, when he had simply mentioned that they *had* moved his pillow. This caused confusion and resulted in incorrect positioning of the patient:

Manikin scenario

Levi: you've moved my pillow

Learner 3: move the pillow

Learner 2: okay, okay, I will move it for you [removes pillow from under Levi's head]

Learner 3: does it feel better now?

Levi: er, well, better than when you moved it before yeah

Learners: [mumbling together/incoherent]

Learner 2: I am lifting you again

Levi: what are you doing?

Learner 1: [puts pillow back under Levi's head] is it better now?

Levi: it is, yeah (Group 4)

Within the Human SP scenario, learners were unsure and confused about physical elements of the scenario, for example, how to use the bed controls, and how to move equipment into the best position for the patient:

Human SP scenario

Learner 3: we can just maybe take the bed up so that he's in a comfortable position

Learner 1: I think they're [points to bed controls]

Learner 3: ahh [fiddling with bed controls] which one is it? [lifts Levi's legs by accident]

Learner 1: just put his legs down as well, they both came up at the same time

Learner 3: alright [fiddling with bed controls] can you help, I can't see it

Learner 2: [moves round to help Learner 3] (Group 2)

Learner 2: erm, but then if we want to get up, the chair's here, so

Learner 3: we should really come this side

Learner 2: [to Learner 1] we can just take the chair round

Learner 1: we can easily move the chair exactly. Well shall we see how we go, coming this way, this side of the bed and then see how that goes and then we can easily move the chair can't we (Group 3)

Learner 1: [to Learner 2] oh, erm, press the on button first if it's the same as the…and then the up [bed starts to move] oh, other way

Learner 2: okay [fumbling with bed controls] (Group 4)

The extracts above show how, although they were demonstrating that there was uncertainty in the learning environment, the learners communicated well and worked together to overcome their confusion. Learners moved their own position so they could intervene and help with the bed controls, they made useful suggestions, for example, about changing the position of the chair and offered support in the form of verbal instructions. These techniques alleviated the sense of *being confused* and produced a positive outcome.

During the Paper-case, learners' confusion mainly stemmed from knowledge deficit, which was compounded by lack of support from an embedded facilitator, who would ordinarily step in with a cue to support learners and progress or facilitate the learning:

Paper-case

Learner 1: …what's it called? Is it PARS[15], is that one?

Learner 2: erm, [quietly] I don't know

Learner 1: [frustrated] oh, I've seen staff come to do assessments on patients, I can't remember what it's called

Learner 2: I've done PHQ9[16], that's like an anxiety and depression thing

Learner 1: okay, yeah, so you really could say get Alana to be kind of, do, erm, assessments for them, and you just put query that one you just mentioned

Learner 2: [writing on paper case]

Learner 1: I think it is PARS, because I think it's patient anxiety, something depression score, but I can't remember what R is, restlessness? [laughing] I don't know. Erm (Group 1)

Here the learners voiced their confusion, stating 'I can't remember what it's called', 'I think it's PARS'. It's not clear, however, if they were referring to the Paediatric Anxiety Rating Scale (PARS) (Research Units on Pediatric (sic) Psychopharmacology Anxiety Study Group, 2002), an assessment scale used to measure the anxiety symptoms in children, which would be unsuitable for use with adults or the Patient At Risk Score (PARS). They attempted to work together to try and interpret the case and work out which assessment tool would be suitable to use, but remained confused and did not select the most appropriate tool available. This confusion led to learners adjusting their behaviours, showing signs of under confidence and frustration, for example, by speaking quietly and placing their head in their hands.

Learners in one group struggled to make sense of some of the data presented in the Paper-case relating to common medical terms and acronyms:

[15] PARS = Paediatric Anxiety Rating Scale or Patient At Risk Score
[16] PHQ-9 = Patient Health Questionnaire, depression module

Paper-case

Learner 1: the airway is patent, self-ventilating, no cyanosis, breathing is good expansion, all the areas, no accessory muscle use, no increased work of breathing, normal breath sounds, cough is adequate. Circulation, the skin is pale, warm, CRT[17] *is…erm? CRT is what? I know it*

Learner 3: cardiac re…

Learner 1: two seconds [to Learner 2] You know what CRT is?

Learner 2: it's circulation

Learner 1 & 3: [laughing] alright. UO[18]*?*

Learner 2: yeah, MMT testing[19]*, because they say the limbs are weak, so…*

Learner 1: they don't do MMT here

Learner 3: [laughing]

Learner 2: they don't do it?

Learner 1: his temperature is high so we might go on to check…[incoherent]…if he had an infection

Learner 3: is he high? Thirty-six, not thirty-eight

Learner 1: temperature

Learner 3: yeah, I think it's okay

Learner 1: it's okay?

Learner 3: because it's between thirty-six to thirty-seven thirty-eight, so it's normal

Learner 3: everything seems alright, what is that, pupils, what does that mean?

Learner 1: pearl[20]

Learner 3: pearl, can't remember (Group 4)

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[17] CRT = Capillary Refill Time, a measure of the time it takes a capillary bed in the fingers, to regain colour after pressure has been applied to cause blanching. CRT of 3 seconds or more may indicate the presence of circulatory shock.

[18] UO = Urine Output, how much urine is produced

[19] MMT = Manual Muscle Testing, a grading system assessment that measures muscle strength and function

[20] PEARL = Pupils Equal And Reacting to Light, pupil dilation reflex measured by shining a pen torch in a patient's eye

In the extract above, learners in Group 4 were observed to be confused by three common abbreviations (CRT, UO and PEARL). They also suggested using a technique that is not commonly carried out in the UK (MMT), and they misinterpreted the patient's body temperature, stating it was 'high' when it was, in fact, within the normal range. This confusion around common acronyms, abbreviations and misinterpretation of physiological observations meant that the group were unable to correctly interpret the physiological observations and assess the patient. This may have been as a result of being overwhelmed with the amount of information presented. However, confusion could have arisen due to cultural differences; the group was comprised exclusively of international students, or it could have been due to other factors associated with uncertainty in the learning environment. This group communicated together to attempt to overcome the issues, often correcting each other's errors and making alternative suggestions.

6.2.4.2 Subtheme: Miscommunication

Learners were observed to be using some technical language, which the patient did not fully understand, followed by a lack of explanation. Furthermore, in both the Manikin scenario and the Human SP scenario, learners sometimes used non-assertive communication skills, rather than explicit instructions, which caused uncertainty for the patient and embedded facilitators:

Manikin scenario

Learner 2: shall we have a bit of a, bit more of a sit up in bed Levi, to see if that helps your breathing a bit more? (Group 2)

Learner 2: shall we try and do a cough Levi? (Group 2)

Human SP scenario

Learner 2: …[to the Nurse] are we ok to grab these shoes for Levi? (Group 1)

Learner 1: [to Levi] …we can try and sit over the edge of the bed couldn't we (Group 4)

Here the learners used phrases such as 'shall we' and 'are we ok to', which gives the patient options, and could lead to confusion. Additionally, by asking the nurse 'are we ok to grab these shoes for Levi' caused uncertainty. Using the term 'are we' was unclear if the 'we' was the nurse or the learners. The nurse was not sure if she was expected to go and get the patient's shoes or if the learner was asking for permission to go and get them. This could have been avoided by making direct statements, giving clear instructions and using assertive language, for example, 'I would like you to' or 'I'm going to assist you to sit up in bed' or 'would you go and grab the shoes'. Using easy to understand language and clear instructions would have aided the patient, by enabling them to quickly comprehend their requirements. It would have also improved communication between group members and additional people embedded into the scenario.

There were also examples of poor communication and miscommunication, which led to the patient *acting confused*. For example, one group told Levi *not to talk* while he was having his blood pressure taken, then conversely, another learner asked him a direct question about what he was reading, requiring an answer from Levi. This miscommunication caused the patient to *act confused* as he did not know whether to answer or not:

Human SP scenario

Learner 1: just have a relax, don't talk at the moment [cuff inflates]

Levi: does everything look alright?

Learner 1: I'll talk to you when I've taken your blood pressure

Learner 2: what is it you're reading there Levi? [Learner 1 turns round to look at Learner 2, smiling]

Levi: oh it, its [turns book over and shows Learner 2 the cover]

Learner 2: sounds interesting

Levi: very interesting, yeah

Learner 1: that's all fine [takes cuff off Levi's arm]

Learner 2: good (Group 1)

Further miscommunication between group members during the Human SP scenario was related to moving and handling; groups discussed whether they would move the patient 'on three' or after the word 'three', with one group communicating that they would 'go on three', then using the word 'stand' as the command to instruct the patient to stand. These examples are highlighted below:

Human SP scenario

Learner 1: yeah, so if we do one two three and then we're going to have a good sit up

Learner 2: go on

Learner 1: is that alright?

Learner 2: are we going on three? [Learner 1 nods] Everybody happy, yeah? Going on three?

Learner 1: one, two, three [Learners 1 & 2 push Levi from behind his shoulders, Learner 1 slides his left leg over to the edge of the bed] (Group 1)

Learner 2: okay?

Learner 1: shall we go on three?

Levi: what's happening? I don't know what I'm supposed to do, what am I doing?

Learner 1: we're just standing, alright, we're gonna go on three, you're gonna rock forward, one, two, and then we're gonna go

Levi: right okay

Learner 1: okay?

Levi: yeah

Learner 1: you ready?

Levi: yeah

Learner 1: so you need to come forward with us. Right, you're not going to fall

Learner 2: that's it, ready

Learner 1: one [pause] two [pause] three. Stand, tuck your bottom in (Group 2)

This is a common communication error when assisting patients to move, and demonstrated a training need for the learners, which was raised during the debrief following the scenario. A more appropriate method for communicating to a patient and team members may have been to use the phrase, 'ready, steady, stand', rather than 'one, two, three,' as it removes any uncertainty.

Other miscommunication led to the patient being unsure of what was required of him, which, in turn, involved him *acting confused* and asking questions and seeking further clarification and explanation from the learners:

Human SP scenario

Levi: what's happening now, what am I doing?

Learner 1: so we're going to step round

Levi: what's happening now, what am I doing?

Learner 2: we're going to step to the chair (Group 2)

Levi: what do you want me to do, sorry (Group 2)

Levi: what is it you want me to do?

Learner 1: that's it, just bringing your arm all the way over to me (Group 3)

Learner 1: [speaking incoherently]…just hover

Levi: what am I doing, sorry? (Group 3)

Learner 2: okay. Can you just lift your hand from the shoulder?

Levi: lift my hand from the shoulder?

Learner 2: yeah, lift it up

Levi: to my shoulder?

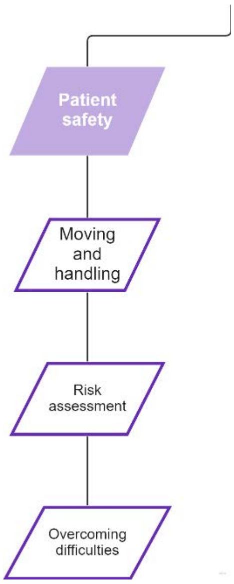
Learner 2: yeah, without bending the elbow

Levi: without bending it? Oh right, I get you, yeah, yeah. I can do that (Group 4)

These excerpts demonstrate how the patient was *acting confused* using phrases such as 'what's happening', and 'what do you want me to do', which prompted the learners to use clearer language and explain themselves to avoid miscommunication and rectify any uncertainty.

Category 3: Task Management

6.2.5 Theme 5: Patient safety



During each of the scenarios, learners carried out tasks, which involved using their clinical and practical skills. Their behaviours were shaped by the information presented, including environmental cues and verbal cues. One theme that arose from the data in all three scenarios was associated with patient safety, specifically related to task management for moving and handling, risk assessment and ways in which learners overcame difficulties.

6.2.5.1 Subtheme: Moving and handling

Two of the groups in the Manikin scenario showed examples of incorrect moving and handling practice, including lifting Levi underneath his armpits, and lifting his shoulders and head incorrectly. This put the patient at potential risk of harm and was addressed during the debrief following the scenarios:

Manikin scenario

Learner 2: [places stethoscope around neck, moves to head of bed – speaking to Learner 1] move the bed out a bit [moves bed away from the wall & re-applies brakes]. That's it. Right, just gonna have a sit up and then I can listen to the back as well, is that alright?

Learner 1: [reaches under Levi's armpit to grab arm] Okay, I'll just help you to sit forwards

Levi: [groaning] (Group 1)

Learner 2: [to Learner 3] I'll, I'll lift his shoulders

Learner 3: okay

Learner 2: then you position. Lift the head up

Levi: [groaning] (Group 4)

The incorrect moving and handling practice illustrated in the extracts above could have been due to skill deficit or a training need. However, it is possible that this incorrect practice may have been linked to the fact that the patient, in these cases, was a heavy high-tech manikin. The manikin does not assist when being moved, it cannot sit up by itself and its limbs do not move in a usual manner; the arms, for example, are stiff and do not bend in the way that a human would. Furthermore, all of the weight is in the top half of the manikin, making it difficult to manoeuvre. This could provide some explanation as to the poor moving and handling practice observed during the Manikin scenario.

Even so, during the Human SP scenario, learners were observed to be pushing, pulling, and lifting Levi incorrectly:

Human SP scenario

Learner 2: are we going on three? [Learner 1 nods] Everybody happy, yeah? Going on three?

Learner 1: one, two, three [Learners 1 & 2 push Levi from behind his shoulders, Learner 1 slides his left leg over to the edge of the bed] (Group 1)

This incorrect practice, plus the associated miscommunication around moving and handling described in Subtheme 6.2.4.2 suggested that further teaching, learning, and repeated practice was required for these learners in this area for skill development.

Moving and handling was also a key area during the Paper-case, where learners were presented with information about Levi's requirements for moving and handing: *Upon discharge, the Physiotherapist recommended moving and handling with assistance of 1 from bed to chair or wheelchair* (MAICIP Simulation C, Appendix K) and an image of Levi's bruised wrists. This presented the learners with a dichotomy whereby they needed to consider whether Levi was being hurt deliberately or as a result of poor moving and handling practice. This prompted the learners to discuss Levi's mobility, strength and needs:

Paper-case

Learner 1: okay, so, yeah we've got all that, we've got all these already, so I assume that we've used them to do that so, erm, consider moving and handling, they've given us a slide sheet (Group 1)

Learner 2: erm, I think it's [reads paper case] moving and handling with assistance of one, so that suggests not mobile, it suggests just transferring with one

Learner 1: now I think on the next one it says he is mobile round the room, in which case, how is he, how is he getting up unaided? There [points and reads from paper case] able to reposition self and assisted movement, mobile around living room with Zimmer frame, tends to leave this and use furniture to assist instead (Group 2)

One group also recognised there may be a training need for Levi and his wife, and suggested that they would teach Alana safe moving and handling practice as part of their action plan:

Paper-case

Learner 2: you could give her like safe moving and handling, or like just get her involved in and say you're doing it wrong

Learner 1: [agrees] [writes on paper case]

Learner 2: yep

Learner 1: and then we'll put about poor moving and handling techniques

Learner 2: yeah (Group 3)

During the Paper-case all four groups acknowledged the patient's bruised wrists could have been linked to poor moving and handling practice, however, it is apparent from the Manikin scenario and Human SP scenario that the learners, too, could be responsible for carrying out unsafe moving and handling, thus requiring further education and training. While there were some examples of safe moving and handling practices, the negative examples have been described in relation to Theme 5: Patent safety, as they could have potentially placed the patient at risk of harm.

6.2.5.2 Subtheme: Risk assessment

Assessment of risk is a task that all healthcare professionals conduct on a regular basis. Risk assessments can be formal, written documents or a mental acknowledgement prior to carrying out a task or upon entering a new environment. During the Manikin scenario, all learners carried out an informal assessment of the situation and associated risk of keeping Levi at home. Two groups identified the risk as high and decided to call for immediate assistance from paramedics, who would transfer Levi to hospital. The other two groups decided that Levi's risk of harm was low and decided to leave him at home, while making referrals to other healthcare professionals in the community.

During the Human SP scenario, two of the groups carried out a risk assessment of the environment prior to moving Levi out of bed. Here learners in Groups 1 and 3 considered Levi's safety and risk of slipping:

Human SP scenario

Learner 1: [looking around] have you got any erm…shoes

Learner 2: some shoes behind me here

Levi: yeah I've got some shoes somewhere

Learner 2: you have. [To the Nurse] are we ok to grab these shoes for Levi?

Nurse: [Picks up shoes and walks over to Learner 1 with them] (Group 1)

Learner 1: shall we get your shoes on…we don't want you to slip on your socks do we?

(Group 3)

Conversely, two groups did not consider risk or safely prepare the patient or environment prior to moving him. In these cases, the learners did not ensure the patient's shoes were available to prevent him from slipping, they did not move a chair into the correct position for him to sit down, nor did they prepare themselves for receiving the patient, once he had been moved from the bed, resulting in alarm prior to Levi almost falling:

Human SP scenario

Learner 1 [to Learner 2 & Learner 3] if we help him into the chair, because he'll fall backwards, help him down, help him down (Group 4)

In this example, the learner in Group 4 was observed to say 'help him down, help him' urgently and loudly, thus requesting assistance from the other learners before Levi fell backwards into the chair. They could have prevented this panic by being better prepared, by managing their task more appropriately and by using improved risk assessment techniques to predict and prevent harm to the patient.

Despite this, while moving Levi, the learners in the same group (Group 4) carried out continuous assessment, taking to him and monitoring prior to sitting him in the chair, to ensure he was feeling well enough to continue:

Human SP scenario

Learner 1: you still feel okay?

Levi: feel great, yeah

Learner 1: not dizzy or anything? (Group 4)

Risk assessment was also noted during the Paper-case, in relation to whether learners considered Levi to be at risk of becoming critically unwell and also for assessing his risk of falls:

Paper-case

Learner 1: NEWS[21] *score zero indicates that he's at low risk of erm becoming critically unwell essentially isn't it, so no need for*

Learner 2: it's like no physiological concerns, then eh

Learner 1: yeah yeah yeah [reading out while Learner 2 is writing] no need for emergency care (Group 1)

Learner 2: and he's a falls risk isn't he, where there's reduced, put falls risk because attempting to, attempting to sort of mobilise (Group 2)

[21] NEWS = National Early Warning Score, used to detect and respond to clinical deterioration in adult patients. It is a key element of patient safety and improving patient outcomes (Royal College of Physicians, 2017)

Learners also identified whether Levi was at risk of harm due to safeguarding concerns and which risk assessment tools they would utilise to assess the level of risk for both the patient and his wife:

Paper-case

Learner 1: [nodding] um. So [pointing at paper case] what've we got on there? Consider risk and assessment and risk rating tools, how we gather information, is he at risk of harm now and in the future, yes! Consider Alana's mental health and risk assessment, so erm, there's different tools isn't there to assess, they use them in hospitals (Group 1)

Learner 1: [talking over the top of Learner 2] I'd put yes he's at significant risk of harm

Learner 2: yeah, assess level of risk
Learner 1: yeah, but I don't know how you'd do a risk assessment for like level of harm
(Group 1)

Learner 1: [writes on paper case] erm, so, proceed with manual handling risk assessment
Learner 2: er, if, and if wife returns to teach her to get him up, correct technique, to protect herself and patient (Group 2)

Learners in Group 1 identified that Levi was at risk of harm and considered tools they would employ to assess Alana's mental health. Learners in Group 2 also suggested that they would teach Alana safe moving and handling practice following their assessment of Levi's risk.

Risk assessment was a key area linked to patient safety. It was apparent that all learners in each of the scenarios were consciously and unconsciously assessing the level of risk and drawing conclusions from the information that was presented. They processed the data and made decisions to carry out tasks, based on their findings. The learners also considered specific formal assessment tools that they may integrate to assist in the safe care of their patients.

6.2.5.3 Subtheme: Overcoming difficulties

Some learners were observed to arrive at the scenarios fully prepared to engage with the scenarios that were presented. They completed and managed the required tasks to meet the learning objectives. Learners consistently considered patient safety and risk. However, during the Manikin scenario two groups arrived at the patient's simulated home unprepared; one group did not bring the required kitbag with equipment to fully assess Levi, another group were unable to find the pen provided to write down his physiological observations. They would have been better able, and more effective, when carrying out their assessment of the patient's condition, had they arrived prepared:

Human SP scenario

Learner 2: have you got a pen lying around Levi? I need to record these

Learner 1: [emptying red kitbag onto armchair] right we'll just jot these observations down Levi, if it's alright with you, and then we'll do a respiratory assessment

Levi: okay

Learner 2: [picks up a stethoscope] Levi, am I alright to have a listen to your chest?

Levi: [quietly] yeah

[Learner 1 still looking around for a pen] (Group 1)

Learner 1: [facing Learner 2] we don't have a stethoscope with us

Learner 2: …[to Hollie] you've not got a stethoscope have you [laughing]?

Hollie: [shakes head] (Group 2)

The learners in the examples above asked for a pen from the patient, and searched the environment for a pen, however, they were unable to make a note of Levi's observations on his chart, opting to memorise the observations instead. In the second example, the learners in Group 2 realised they could not carry out the required chest assessment as they did not have a stethoscope. This group showed examples of overcoming difficulties, when they realised that they had misplaced the kitbag or forgotten to take it into the Manikin scenario with them:

Learner 1: [facing Learner 2] we don't have a stethoscope with us

Learner 2: no, shall we have a feel?

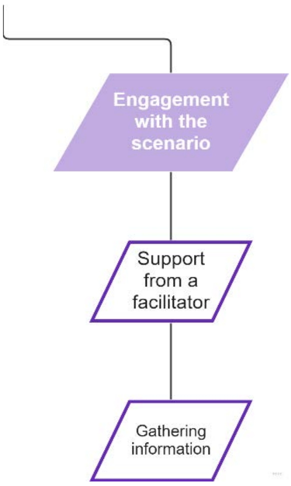
Learner 1: yep, expansion

Learner 2: [to Levi] I'm just going to, do you mind if I just pop my hands on your chest Levi, is that alright just to have a feel? (Group 2)

This group adapted their behaviours to overcome difficulties and suggested an alternative way to assess the patient, by feeling for chest expansion, rather than auscultating his chest.

Other learners show examples of overcoming difficulties when they were struggling or finding the scenario difficult. They often relied on other members of the team for assistance and looked to the embedded facilitator for support and guidance. This resulted in the learners participating within their scope of ability in safe learning environments, whilst considering risk and patient safety throughout their scenarios.

6.2.6 Theme 6: Engagement with the scenarios



Learners actively engaged with all three scenarios, but there was a notable difference in their behaviours between the physical scenarios (Manikin and Human SP scenarios) and the Paper-case. Analysis of the transcripts revealed that the ways in which learners engaged was largely due to the facilitation they received and how they gathered information.

6.2.6.1 Subtheme: Support from a facilitator

During the Manikin scenario and Human SP scenario learners engaged actively and physically with a patient, embedded facilitator, equipment, props and each other. Despite there being no Manikin patient or Human SP present during the Paper-case, two of the groups completed the Paper-case and found it believable. They treated the case as if it were a real patient scenario; the person was very much at the heart of the Paper-case:

Paper-case

Learner 1: but also, we might put the stairs in there, because currently him and his wife are sleeping separately, and that's a massive thing, isn't it

Learner 2: unable to use stairs, so yeah, unable to use stairs

Learner 1: yeah [writes on paper case]

Learner 2: yeah, so sleeping separately from wife, it is important, could that be adding to the strain, it's not fair at all (Group 2)

Learner 2: check his environment, see if he can do stairs, he wants to go upstairs (Group 3)

In these examples, the learners took a patient-centred approach, considering Levi's personal needs. One learner stated that sleeping separately from his wife could be affecting Levi's mental health, adding that 'it's not fair at all'. Another noted that one of Levi's goals was to 'go upstairs', referring to enabling Levi to become more independent.

On the other hand, some learners appeared to be less engaged during the Paper-case, one stated that 'it doesn't really matter does it' (Group 3), which could be reference to the fact that the Paper-case was not realistic and therefore their discussions didn't matter or have an impact on the scenario. This same group (Group 3) again became distracted and started to discuss how difficult they were finding the physical act of writing their reflections on the Paper-case:

Paper-case

Learner 1: [writes on paper case] you know, I'm going to struggle in that written exam, because I can't write anymore

Learner 2: [laughing] my last written exam I like ran out of time and put bullet points at the bottom and in the comments it was like you're very unorganised (sic), do not bullet point. Be easier if we could be quicker and type it

Learner 1: it would be good if like they could sit behind us and we could have laptops and they could see that we were only on work the whole time, it would make such a difference, I bet we'd do way better

Learner 2: yeah. You know like we had, erm, like iPads and they can disable everything on them so we can only go on… (Group 3)

Commenting that they 'can't write anymore', the learners drifted off-topic and abandoned the Paper-case to discuss other unrelated items. This may not have happened had there been a facilitator in the room with them to ensure professional behaviours and to keep them on-topic.

In another group (Group 4), one member was observed acting unprofessionally when they took out their mobile phone and proceeded to look at it, rather than engage with the Paper-case. Another member of their team covertly reminded them that they were being recorded and suggested that they should consider their actions:

Paper-case

Learner 2: [takes mobile phone out of pocket and starts messing with mobile phone]

Learner 1: [whispers to Learner 2] you're being recorded (Group 4)

This level of distraction and lack of engagement was not apparent in the Manikin scenario or the Human SP scenario, which could be due to the presence of an Academic facilitator, who modelled professional behaviours and guided the learners to behave appropriately.

Learners encountered boundaries in each of the scenarios, but these were overcome by cues delivered by facilitators in the Manikin and Human SP scenarios and teamworking. The distraction and unprofessional behaviours observed during the Paper-case highlighted the need for the presence of a facilitator to aid, guide and prompt the learners for a smoother conclusion, by providing answers to questions, which would have resulted in less frustration.

There were some examples of strong leadership shown by Group 4 during the Human SP scenario. The self-appointed leader in this group questioned the other team members throughout the scenario, encouraged them to make decisions and urged them to become involved:

Human SP scenario

Learner 1: …okay, right, [to Learner 2 & Learner 3] how do we want to do this?

Learner 1: [to Learner 2 & Learner 3] what are we going to look for when we stand up first? What are we worried about?
Learner 3: falling
Learner 2: falling over
Learner 1: uh huh, yeah, so how can we stop that happening?

Learner 1: So how are you two going to facilitate him into standing? (Group 4)

The level of questioning demonstrated by this learner in the examples above was an exception, not shown in other groups. This learner adopted more of an embedded facilitator/teacher role, rather than a team-member. This could have been due to their own self-efficacy, interest in the scenario, or it could have been due to their recognition that some of the other learners in the group were not as confident in their own abilities. It was not clear whether this learner had been appointed as a team leader by the other members or if they had taken on the role inherently.

The unprofessional behaviours and distraction observed during the Paper-case, when compared to the other two scenarios could be attributed to the absence of a facilitator to guide the learning. It could, however, be due to a lack of interest or disengagement because of their inability to suspend disbelief linked to the lack of realism of the Paper-case. This analysis has clarified the need for a facilitator, despite the learners not physically participating, as the facilitator's guidance and support may have increased engagement, answered some of the learner's questions and reduced the confusion they experienced during the Paper-case.

6.2.6.2 Subtheme: Gathering information

In all three scenarios, learners gathered information in order to inform their clinical decision-making. This information was then processed, and learners made sense of the situation, enabling them to make decisions and progress through the scenario to achieve the learning outcomes by the end of the allocated time frame. During the Manikin scenario and the Human SP scenario, learners gathered information by talking to the patient, asking questions, and clarifying the answers to the questions if they were unsure:

Manikin scenario

Learner 2: and what kind of, what kind of symptoms have you got? What's making you feel unwell?
Learner 1: so you've got a dry cough?
Levi: [weak cough] I don't know
Learner 2: you sound quite out a breath Levi
Levi: Yeah
Learner 2: is that quite a new thing for you? (Group 1)

Learner 2: how are you feeling?
Levi: I'm not feeling well at all really
Learner 1: you're not feeling too well?
Levi: No
Learner 1: [to Learner 2] so sats are eighty nine at the moment, blood pressures ok
Levi: I feel a bit tired you know.
Learner 2: yeah. Do you normally have problems breathing before this or is it just recently?
Levi: oh I don't know, every now and then (Group 2)

In these extracts, learners were observed gathering verbal subjective information from the patient about his current condition and past medical history, along with physiological data.

In the Human SP scenario, learners gathered information, for example, regarding how Levi was feeling related to his previous admission, his current condition, his strength, and ability to move, prior to making decisions about whether to move him out of bed for the first time:

Human SP scenario

Learner 1: you don't feel dizzy or anything?

Levi: no, no I feel great

Learner 1: you're doing good (Group 1)

Learner 1: good, you've got nice control there. Right then can you do the same with that one? Are you able to lift your knee on your own or do you need some help?

Levi: I'll try. I'd like to be able to do a bit better than this but… (Group 2)

Learners also relied on additional information offered by the embedded facilitators, who were in role as the patient's daughter, Hollie, in the Manikin scenario and the nurse in the Human SP scenario. For example, Hollie interjected to provide information about the patient's past medical history, plus additional information, when required, including his surname and address:

Manikin scenario

Learner 1: are these swallowing problems new?

Hollie: he's had them in the past, yeah but, it's like not a regular thing (Group 1)

Learner 2: so, er, does he move in bed, by himself?

Hollie: normally, yeah, I mean he's, they say he's got this thing called low tone

Learner 3: yes

Hollie: so he's a bit floppy and he has spasms… (Group 4)

Learner 1: sorry Hollie, what's your dad's surname?

Levi & Hollie: Williams (Group 1)

Learner 2: [to Learner 3] sorry, have we got his address on there?

Hollie: address? 1 Shepherds Way (Group 3)

During the Human SP scenario, information was shared by the nurse about Levi's physiological observations, his catheter and how he had been feeling generally. The nurse, additionally, encouraged the learners to speak directly to the patient, rather than seeking information from her. The nurse reminded the learners the patient was present, saying to Levi 'go on, what would you say':

Human SP scenario

Learner 1: [to Nurse] how are we doing?

Nurse: he's had a cracking night, really good, yeah. Erm, I'm around, whatever you need, I, I can give you a hand

Learner 1: but slept well have you?

Nurse: yeah. Go on, what would you say?

Levi: yeah, I did sleep well last night, yeah

Nurse: handover from night staff has been, yeah, no problems, no interruptions, actually slept (Group 1)

Learner 1: and just when were his last obs taken?

Nurse: an hour ago, they're on there [points to chart at end of the bed]

Learner 1: they're on there?

Nurse: everything's on there for you. Dynamap's there for you, so if you need to take anything else it's there but…erm, obs an hour ago, alright (Group 3)

The nurse, in role, encouraged the learners to gather data from the environmental cues, including the observations chart, patient monitor, prompted them to use equipment that was available and reminded them about health and safety, for example, trailing leads, that could cause a potential trip hazard. The nurse also provided additional information to push the scenario forward:

Human SP scenario

Learner 3: we need to monitor his vitals

Nurse: they're on now, the Dynamap is there. You just need to pull, if it doesn't reach now for this side, you'll have to pull it on the trolley

Learner 2: alright

Nurse: yeah, just bear in mind the erm, lead (Group 2)

This facilitation was necessary to enable the learners to gather information effectively and safely engage with the scenarios.

During the Paper-case, the learners gathered data directly from the Paper-case and they also integrated information that had been previously provided regarding Levi's profile and personal circumstances, which they related and applied to the Paper-case:

Paper-case

Learner 2: you know, erm, when he, before this he was using crutches wasn't he?
Learner 1: yeah, so he's on a Zimmer frame now, that would, it would appear to suggest that he's needing maximum help of one to sit-to-stand doesn't it? (Group 2)

Learner 1: shall we write the last part involving the family members as well, like his children to come and stay with him?
Learner 2: no, but no, because they're basically living far, so they can't come (Group 4)

These extracts demonstrate how the learners gathered, retained, and integrated additional social data, for example, when the learner remembered '*he was using crutches wasn't he*', which they had observed on the video vignette introducing Levi. There was also discussion about involving Levi's wider family members in his care. The additional social data that learners integrated into the Paper-case included information regarding Levi's ability to mobilise independently, his use of walking aids, and where his family members were based. They worked together to design an action plan for Levi's assessment and care, utilising the written and visual data at their disposal, along with previously provided information, which they integrated from the introductory video and other two scenarios.

6.3 Chapter summary

Each of the six themes and subthemes have allowed the opportunity to identify and examine the social data to gain an understanding of underlying thoughts and assumptions associated with the three scenarios. This approach has enabled a deep understanding of the learner's behaviours and shed light on the different scenarios, providing a detailed analysis of the transcribed observational data. Themes 1 and 2 were linked to situational awareness; Theme 1 was used to gain an understanding of how and when learners raised concerns, while Theme 2 generated a deeper understanding of how learners in the three scenarios recognised and responded to the patient's condition, some barriers to their learning linked to the realism of the scenarios and how the learners identified environmental cues. Themes 3 and 4, associated with communication and teamworking, identified differences in the scenarios related to silence, expressive touch, and consent. In addition, insight was gained into how learners recognised and responded to verbal cues, confusion they experienced during the scenarios and communication that arose because of uncertainty in the learning environment. Finally, Themes 5 and 6, aligned to task management, developed insight into the importance of patient safety and how learners engaged with the scenarios. These themes explored risk management, and how learners overcame difficulties, as well as discovering how learners gathered data and the importance of support from a facilitator to aid learning during simulation-based education. The qualitative findings presented in Chapter 6 are discussed in Chapter 7, where the quantitative findings from Chapter 5 will also be integrated and synthesised, to gain a comprehensive picture of the effect of realism on undergraduate student learner's engagement and emotional response during simulation-based education.

CHAPTER 7 - DISCUSSION OF THE FINDINGS

7.0 Chapter overview

This penultimate chapter will discuss the implications of the findings that have been presented in Chapters 5 and 6. The findings in relation to each research question will be discussed in detail. Qualitative and quantitative findings will be integrated, supported, or disputed by the previous literature, which was presented in Chapter 2. Finally, the limitations of this study will also be discussed. Conclusions will then be drawn in Chapter 8, along with recommendations for policy, practice, and future research.

7.1 Main research findings

The overarching aim of this study was to explore three different simulation-based education modalities; to discover whether these modalities had an effect on the quality of simulation-based healthcare education and the student learning experience, leading to enhanced knowledge, self-efficacy and positive emotions and behaviours. To this end, a study aim and objectives were constructed and the research conducted to explore the overarching research question. The discussion of the findings is related to this research study specifically and acknowledges the limitations of a small subject-specific group of pre-registration (Level 7) learners, therefore generalisations have not been made to the wider population. Nevertheless, reliable, and valid data collection tools were used in the quantitative arm of the study, and the qualitative arm of the study was deemed to be trustworthy, as described in Chapter 3, Section 3.5.1. Therefore, the findings can be said to be credible, transferable, dependable, and confirmable (Lincoln and Guba, 1985) and the overall study has 'educative authenticity' (Bryman, 2012: 393), meaning that the perspectives of others in the social learning setting were considered with the intention of making positive changes for the future. Whilst generalisations have not be made, the detailed or thick descriptions (Lincoln and Guba, 1985) of the methods used in this study and clear reporting of the research process ensures the research can be replicated in other groups, contexts, situations, and populations. Therefore, the findings may be applicable to similar settings and other learners involved in simulation-based healthcare education. Those who seek to transfer the findings of this current research study can make pragmatic choices about the acceptability, usefulness, and transferability of the findings (Nowell et al., 2017).

The theoretical framework that underpins this research, Bandura's Social Learning Theory (1977a), will be utilised to synthesise the findings from the individual research questions. These will be drawn together using the determinants of behaviour; Personal, Behavioural and Environmental factors described in Section 3.2 and depicted in Figure 3-1, as these align explicitly with the findings.

7.1.1 Personal factors

Bandura (1977a) stated that personal factors include learner's cognitive abilities, self-efficacy beliefs and their attitudes. In this research study, learner's cognitive ability was measured quantitatively using a knowledge visual analogue scale (VAS). Their self-efficacy was measured quantitatively using a general self-efficacy scale (GSES) and learner's emotions were measured quantitatively using an emotion wheel (GEW). These scales were used to gather data from learners engaging with three difference scenarios, which used different modalities of simulation, one with a high-tech manikin patient, the second having an embedded human simulated patient (SP) and the last scenario, which was a paper case-study. The discussion related to personal factors addresses the following three Study objectives:

b) To explore whether realism effects learner's knowledge

c) To gain a baseline measure of learner's self-efficacy to explore the effect of self-efficacy on undergraduate student's ability to cope with the challenge of different simulation-based education scenarios

d) To gather data on the intensity of learner's emotions before and after engaging with different simulation-based education scenarios

Objective a), linked to realism, will be discussed later in Section 7.1.3 in relation to Environmental factors associated with this research study.

As noted by Cassidy (2012: 796), 'it would be both naïve and remiss to overlook age, gender and prior academic attainment as pertinent personal factors' that can significantly affect both self-efficacy *and* academic achievement. Mature students traditionally possess increased motivation and 'superior study skills' when compared to non-mature students (Cassidy, 2012: 797). The learners involved in this research study were all mature students, with ages ranging from 21-50 years. They brought with them to each of the scenarios their prior academic achievements, plus additional life experience. Most learners involved in this research study were women (82%). It has been reported that gender plays a significant role in academic achievement; Richardson and Woodley (2003) and Sheard (2009) claimed that women outperformed men on both final grade point average (GPA) and final year dissertation mark. Cassidy (2012) also discovered that student learners who possessed any relevant prior academic achievement and are mature are more likely to achieve greater success within higher education. This is important in relation to this current research as the majority of participants were female, mature students with previous experience of higher education, possessing degrees including BSc, MSc, and PhD. Their age, gender and prior academic success would have impacted on their personal factors, including knowledge and self-efficacy; their ability to cope with, and their emotions related to, the three different scenarios.

7.1.1.1 Objective b), enhancement of knowledge

In this research study, Objective b) aimed to explore whether realism effected learner's knowledge. To discover this, learner's knowledge was assessed prior to, and following, each scenario using a visual analogue scale (VAS), which was linked to four specific scenario learning outcomes (Appendix E). Knowledge scores ranged from low to high (zero to forty). This research discovered the following four key points related to learner's knowledge (Table 7-1).

Table 7-1: Research findings related to learner's knowledge

1	Prior to each of the three scenarios, there was no difference in the learner's pre-scenario knowledge scores (p=0.07), meaning that the learners went into each of the three scenarios with equivalent knowledge
2	There was a difference in learner's post-scenario knowledge scores; scores were significantly higher (p=0.01) after the Human simulated patient (SP) scenario (26/40) and Paper-case (29/40), when compared to the Manikin scenario (19/40), therefore, learners had significantly more knowledge after participating in the Human SP scenario and the Paper-case
3	There was an increase in pre-to-post knowledge scores following the Human SP scenario (22/40-26/40, p=0.01); learners gained significantly more knowledge after participating in the scenario with an embedded human SP
4	Knowledge scores decreased following the Manikin scenario, although this result was not significant (p=0.6)

In order to explain these findings, one must consider why learner's knowledge was lower following the Manikin scenario and increased after simulation with an embedded human SP and following the Paper-case. The systematic review by Hamstra et al. (2014), argued that high structural fidelity (the appearance of the simulator) can cause distractions and direct attention away from the primary learning objectives during a scenario. Hamstra et al. (2014) suggest that these distractions can lead to an inability to learn effectively. This suggests that learners in the current research may too have been distracted by the appearance of the manikin during the Manikin scenario and therefore, they were unable to learn effectively and hence, their knowledge decreased. Hamstra et al. (2014: 389) advocate the use of 'functional task alignment', which means aligning any equipment used with the functional requirements of a task.

Hamstra et al. (2014) also suggested there was an optimum area where structural fidelity (the appearance of the simulator) and functional fidelity (what the simulator does) is balanced, which promotes learning. In the present study, the optimum area where structural and functional fidelity was balanced seems to be during the Paper-case, where overall the knowledge scores were at their highest (29/40), when compared with the other two scenarios. This suggests that there were no distracting effects from technology or embedded participants and learners were able to achieve a higher level of knowledge after engaging with the Paper-case. However, the intention of simulation-based education is to ‘promote transfer of learning to the clinical setting’ (Hamstra et al., 2014: 390), therefore, paper-based case studies should be used where the objectives are related to knowledge-gain as opposed to technical and non-technical practical skills. This further highlights the need to align tasks to the required learning objectives (Hamstra et al., 2014).

Bender (2011) carried out a macro-systems simulation, which was conducted in-situ, in a real hospital environment with real patient monitors and equipment, arguably a highly realistic simulation. During this study, a functioning intensive care unit was simulated before it opened. Bender (2011) advocated the use of environmental cues, realistic documentation, embedded human simulated patients and trained facilitators to enhance scenarios. They also stated that high-tech manikins were only used where necessary. Bender (2011) acknowledged that their findings may not be generalisable to other institutions, however, their findings suggested that objectives *can* be met whilst outside of the optimum area for learning, where both structural fidelity and functional fidelity are high. This current study supported the work of Bender (2011) as it demonstrated that the highest form of structural and functional realism, a scenario with an embedded human SP, enhanced learner’s knowledge, despite the potential for distraction outside of the optimum area for learning (Hamstra et al., 2014). In the Human SP scenario, where both structural fidelity and functional fidelity were high, there was a significant pre-to-post knowledge gain (22/40-26/40, p=0.01).

Schaumberg’s (2015) critical commentary noted that there is a lack of scientific evidence as to how much learners should be stressed in order to achieve positive learning outcomes and suggested that further research was necessary to explore the impact of realism on knowledge transfer. Furthermore, Keitel et al.’s (2011), cross-over study noted that stress induced by heightened simulation realism could be detrimental to knowledge transfer: ‘high stress response might counteract educational efforts associated with training using high-fidelity patient simulation’ (Keitel et al., 2011: 99). This current research aimed to explore realism and knowledge transfer to provide further insight. My results revealed that learners in the scenario with the highest level of realism (Human SP scenario) demonstrated a significant pre-to-post knowledge gain. This was probably due to the learner's positive emotional response to the human SP; this scenario was the most realistic and their emotional response was more positive following the Human SP scenario. Knowledge transfer was not negatively affected using this modality, which contradicts Keitel et al.'s (2011) findings. However, Keitel et al. (2011) embedded a high-tech manikin into their simulated emergency situation to induce stress, so the findings are not directly comparable. My current research study complements the work of Poeschl and Doering (2013), during their development of the VR Simulation Realism Scale, who claimed that realistic models and environments lead to higher performance. In the current research study, despite learner's experiencing a potentially stressful simulation, this higher simulation realism gained by embedding a human simulated patient led to greater transfer of knowledge and positive emotional response.

The results of this current study reveal that learner's knowledge was impacted by the realism of the simulation they experienced. The distracting effects of a manikin may have had a negative impact on knowledge gain and caused knowledge to decrease. The heightened realism induced by a realistic human simulated patient seems to have had a positive impact on learner's knowledge. In addition, the paper-case provided an optimum area for learning, enabling learners to gain the most knowledge; potentially due to having no distracting effects of technology or embedded participants. Order effects, repeat effect and the impact of illusory truth on the results will be considered later in Section 7.2. These current findings should be considered when designing scenarios in the future; it is essential to align the simulation modality to the learning objectives to facilitate opportunities for optimum learning to take place. These results also support the suggestion that high-tech manikins should only be used when aligned to specific learning objectives, or when a procedure would be damaging to a human simulated patient.

7.1.1.2 Objective c), the effect of self-efficacy

To investigate whether learner's self-efficacy effected their ability to cope with the challenge of different simulation-based education scenarios, self-efficacy data was collected prior to each of the scenarios using a general self-efficacy scale (GSES) (Schwarzer and

Jerusalem, 1995). Self-efficacy data was analysed to discover whether different situations impacted perceived self-efficacy. This current research discovered that there was no difference in learner's self-reported general self-efficacy between the three scenarios ($p=0.42$); all learners reported high levels of general self-efficacy prior to each of the scenarios. It has been stated previously that high self-efficacy beliefs lead to improved performance in any activity (Bandura, 1997). Interestingly, the learners who participated in the current study were selected as they had no previous experience of simulation-based education. Despite a thorough briefing prior to the scenarios, due to lack of prior experience, they may not have known what to expect before they entered the first scenario; the reason for high reported self-efficacy scores could be that they simply reported confidence in their own abilities without knowledge of the complexity of the scenario or an appreciation of expectations.

The general self-efficacy scale (Appendix E) used to collect data for this study asked questions related to the learner's ability to solve difficult problems, accomplish goals, deal with unexpected events, and manage unforeseen situations. The link between these general questions and the simulation-based education scenarios the learners were about to experience may not have been apparent to the learners; this potentially led to an unrealistically high sense of self-efficacy or a 'false sense of efficacy' (Pike and O'Donnell, 2010: 408). Pike and O'Donnell (2010) presented the findings of their qualitative study which explored the impact of clinical simulation on self-efficacy beliefs in pre-registration nurses. They reported that their participants felt they could not relate the experience gained during simulation to real-life practice. This too could have been true for the learners in the current research study, which is why they could not relate the general self-efficacy statements to the simulation scenarios. To overcome this, Pike and O'Donnell (2010) advocated the use of techniques to enhance the realism of scenarios, which would, in turn, enable learners to link theory, simulation and practical experience to future clinical practice. While Pike and O'Donnell's study participants were pre-registration nurses, the findings are relatable to other pre-registration healthcare students, for example, the pre-registration learners involved in the current research study. Bandura (1997) stated that enhanced self-efficacy equates to improved performance, which was true in my research, where learners all had high self-efficacy beliefs and were able to perform effectively during each of the three scenarios. Pike and O'Donnell (2010) stated that there should be a focus on providing teaching and learning strategies that enhance self-efficacy within nursing education, which is also true for all healthcare students.

Learner's self-efficacy is directly related to other interlocking personal factors (Bandura, 1977a). In other words, low self-efficacy beliefs may impact negatively on cognitive abilities and emotions and vice versa. Equally, a false sense of high self-efficacy would be detrimental to learners who, maybe, entered the scenarios feeling over-confident (Pike and O'Donnell, 2010). This may be explained by order effects; after the first scenario (the Manikin scenario), learners experienced a decrease in knowledge. Here, the learners entered the scenario with high self-efficacy, feeling able to cope with the situation presented to them. During the Manikin scenario, it was noted that learners experienced high intensity of negative emotional responses, reporting an overwhelming sense of fear, regret, and disappointment. Therefore, despite the high levels of reported self-efficacy, learners potentially began to doubt their own abilities and, as a result, their knowledge (cognitive ability) decreased post-scenario.

This current research study aligns with Keitel et al. (2011), who used high-tech manikins during their simulated emergency situation: they discovered that simulation and lab-induced stress (delivering a speech in front of a video camera) elicited the same amount of physiological stress, or endocrine stress response, assessed by saliva cortisol level. They also discovered that a simulated emergency situation was more psychologically stressful than lab-induced stress or a control environment. With this in mind, it is possible to suggest that the learners in my research study had the ability to cope with difficult, stressful simulation-based experiences and the resultant negative emotional responses due to their high self-efficacy. Bandura (1997) claimed that enhanced self-efficacy equates to improved performance, which is apparent in my research as all learners overcame any negative emotional responses, and completed the complex scenarios, to meet the desired learning outcomes.

In 1994, Bandura described self-efficacy beliefs as determining factors that mediate learner's feelings, thoughts, and behaviour. Bandura (1994) also stated that self-efficacy may be a better predictor of performance than actual capability or competency, given that self-efficacy is instrumental in determining what individuals *do* with the knowledge and skills that they hold. To explore this further, in the context of this research, learner's high self-efficacy enabled them to mitigate the high intensity of fear experienced prior to the Manikin and Human SP scenarios, and the significant increase in some other negative emotions (regret and disappointment) experienced during the Manikin scenario. This allowed learners to modify their behaviours so that they could meet the learning outcomes: they adapted their personal factors, linked to verbal and non-verbal communication skills (Theme 3) despite, at times, feeling confused and uncertain in the learning environment (Theme 4).

What has not clearly been ascertained by this research study is whether the learners really did have high self-efficacy, or whether the scale utilised to collect the self-efficacy data was specific or sensitive enough to elicit relevant data. Further research to design and analyse a simulation-specific self-efficacy scale is required to explore this phenomenon in more detail.

7.1.1.3 Objective d), learner's emotions

To gather data on the intensity of learner's emotions before and after experiencing different simulation modalities, the Geneva Emotion Wheel (GEW) (Scherer, 2005; Scherer et al., 2013) was used to measure twenty emotions (Appendix E); ten positive emotions including Interest, Amusement, Pride, Joy, Pleasure, Contentment, Love, Admiration, Relief and Compassion, plus ten negative emotions; Sadness, Guilt, Regret, Shame, Disappointment, Fear, Disgust, Contempt, Hate and Anger. This study discovered that different simulation modalities impact learner's positive *and* negative emotions. Overall, in all three scenarios, the intensity of positive emotions reported by learners were higher intensity than the intensity of negative emotions. A summary of the key findings related to learner's emotions are listed in Table 7-2 below:

Table 7-2: Summary of findings related to learner's emotions

1	*Interest* had the highest intensity of all the positive emotions experienced by learners prior to all three scenarios
2	*Interest* intensity increased following the Manikin scenario (p=0.59) and increased significantly following the Paper-case (p=0.04). *Interest* intensity decreased after the Human SP scenario (p=0.35), although this was not significant
3	*Relief* intensity significantly increased post-Manikin scenario (p=0.04) and post-Human SP scenario (p<0.001)
4	9/10 positive emotions increased post-Human SP scenario, including significant increases in *Pride* (p=0.01), *Contentment* (p=0.03) and *Compassion* (p=0.01)
5	*Fear* had the highest intensity of all the negative emotions experienced by learners prior to all three scenarios. *Fear* emotion was significantly less intense prior to the Paper-case (p=0.03)
6	*Fear* intensity significantly decreased following the Manikin scenario (p<0.001) and the Human SP scenario (p<0.001)
7	All negative, low control emotions increased post-Manikin scenario, including significant increases in *Regret* (p=0.02) and *Disappointment* (p=0.05)
8	9/10 negative emotions decreased post-Human SP scenario, including a significant decrease in the intensity of *Sadness* (p=0.05)

Non-verbal behaviours include facial and vocal expression, for example, smiling/frowning, low/high speech volume and physiological indicators, for example, sweating, increased/decreased heart rate, increase/decreased respiration rate. These non-verbal behaviours can be used to infer the emotional state of a person (Scherer, 2005). However, there are no objective methods to measure the subjective experience of a person during an emotional episode, hence why emotions of the learners during each of the scenarios in this current research study were assessed using the GEW (Scherer, 2005; Scherer et al., 2013). Scherer (2005), advocating the use of a tool to assess emotions, commented; 'there is no access other than to ask the individual to report on the nature of the experience' (Scherer, 2005: 712).

Prior to all three scenarios, learners reported *Interest* as the positive emotion with the highest intensity. However, there was no difference between the intensity of this emotion prior to the scenarios (p=0.42); this indicates that the learners felt the same level of interest before each of the scenarios, irrespective of the modality of simulation. This is a positive finding, as the learners prior to each different scenario were interested and ready to learn. Following the Manikin scenario, the intensity of interest increased and after the Human SP scenario, the intensity of interest emotion decreased, but these results were not significant, so no concrete suggestions for these results can be made. In contrast, there was a significant increase in the intensity of interest following the Paper-case (p=0.04). These findings suggest that the learners in this study were interested prior to the Paper-case, remained interested throughout the duration and after they had completed it.

Another positive emotion, *Relief*, increased significantly following the Manikin scenario (p=0.04) and the Human SP scenario (p<0.001). This indicates that the learners felt relieved to have finished the scenarios with a manikin and an embedded human SP. As mentioned, nine of the ten positive emotions increased following the Human SP scenario, which highlights that learners were in fact feeling more positive generally after the Human SP scenario. There were significant pre-to-post scenario increases in positive emotions, *Pride* (p=0.01), *Contentment* (p=0.03), and *Compassion* (p=0.01), following the Human SP scenario, indicating that the interactions with a Human SP in this scenario had a positive impact on learner's emotions. This was also reflected in the learner's observed behaviours; during the scenario with a human SP, learners appeared more relaxed, and were laughing and making small talk with the patient. They appeared interested to find out personal information from the patient and showed more compassion with the human SP than with the manikin or during the paper-case.

Overall, the intensity of all negative emotions reported by learners were lower than positive emotions in all three scenarios. The lowest intensity of negative emotions was shown in the Paper-case. *Fear* showed the strongest negative emotion intensity in all three scenarios. This current finding aligns with Nehring and Lashley (2004), who reported that learners were anxious and uncomfortable performing in front of their peers, Garrow (2014), who discovered that student nurses felt anxious, exposed, and unsafe during simulation, and

Miller (2019) who recognised that participants in her research felt ‘unease and fear’ related to simulation-based education (Miller, 2019: 217).

After the Manikin scenario, the intensity of seven negative emotions increased (*Sadness*, *Guilt*, *Regret*, *Shame*, *Disappointment, Disgust*, and *Anger*). Two negative emotions in particular, *Regret* (p=0.02) and *Disappointment* (p=0.05), increased significantly post-Manikin scenario. These findings indicate that learners regretted their actions and felt disappointed by their behaviours. *Hate* stayed the same, and both *Fear* (p<0.001) and *Contempt* decreased. This indicates that overall, learners were feeling more negative after the Manikin scenario. In contrast, following the Human SP scenario, nine negative emotions decreased, except *Shame*, which stayed the same, suggesting that learners felt less negative following the Human SP scenario. Following the Paper-case, seven negative emotions (*Sadness*, *Guilt*, *Regret*, *Shame*, *Disappointment*, *Disgust* and *Anger*) increased, while *Fear* (p=0.03) and *Contempt* decreased, and *Hate* stayed the same, implying that learners felt more negative after the Paper-case. However, the overall intensity of negative emotions experienced by learners during the Paper-case, were less than the two physical simulation scenarios. Again, this can be related to learner’s ability to cope with difficult situations and other personal factors; the Paper-case was less distracting, provided the optimum area for learning and induced lower intensity negative emotions. Having no facilitator present also may have reduced learner’s performance anxiety, fear, and defensive behaviours or heightened arousal, which can impact negatively on the opportunity for learning (Bandura, 1977a).

One of the strongest impacts on emotion differentiation is the ability to control the emotions, which is known as coping potential (Scherer et al., 2013). Coping potential is related to self-efficacy. Learners in this current research study reported high self-efficacy, which enabled them to cope with the negative emotions they experienced during the Manikin scenario, allowing them the ability to perform effectively. The high intensity of fear experienced by all learners in all three scenarios could be due to ‘vicarious arousal’ (Bandura, 1977a: 65) or fear learning. Learners potentially created fear responses from their own thoughts, expectations, or fear of the unknown due to having no prior direct experience of simulation-based education. This would explain the significant reduction in fear intensity following the Manikin and Human SP scenarios, as presented in Chapter 5, Section 5.5.7.

Following this research study, one must consider the impact of negative emotions on learner's ability to perform during simulation-based education. Learners felt more positive following the Human SP scenario; this was also reflected in their actions and behaviours. Learner's emotions were more negative following the Manikin scenario, further supporting the notion that manikins should only be used when absolutely necessary; when aligned to specific learning objectives, or if a procedure would be damaging to an embedded human simulated patient.

7.1.2 Behavioural factors

To explore learner's behavioural factors that were influenced by the different scenarios it was necessary to analyse their verbal and nonverbal behaviours, performance, skills, and practices, using structured and unstructured observational analysis. The discussion related to behavioural factors will address Objective e), To observe learner's behaviours during simulation-based education.

Bandura (1977a) revealed that behavioural factors include performance, skills, and practices. In this study, learners were observed, using both structured and unstructured methods to gain an understanding of their behaviours and practices during the three different scenarios. It is important also to acknowledge the inter-dependence of personal and environmental factors, which function as 'reciprocal determinants of each other' (Bandura, 1977a: 195), meaning that each factor effects the other. Emphasising this further, Bandura stated, 'lecturers do not influence students unless they attend their classes, books do not affect people unless they select and read them' (Bandura, 1977a: 195) In other words, the modality of simulation will not affect the learners unless they attend and are open to the learning presented. This reciprocal relationship means that learner's behaviours partly determine which environmental influences come into play, for example, knowing how and when to raise concerns (Theme 1) or understanding patient needs (Theme 2) and formation of resulting behaviours. Environmental influences also affect learner's behaviours, for example, their response to patient safety (Theme 5) or their engagement with the scenario (Theme 6). This two-way process indicates that the environment and the resulting behaviours are influenceable; they can be changed and modified.

Modelling occurred during the three different simulation scenarios. Learners can model behaviours by observing each other (peer-to-peer) or by observing teachers or facilitators. Learners in the current research study modelled their resulting behaviours on their own observations. However, since a facilitator was not present during the Paper-case, learner's behaviours were less professional, and learners appeared to find this scenario content the most difficult. Modelling can also take place through symbolic modelling via television, digital media, or visual cues. Using modelling, learners learn by example, and carry their observed behaviours through to the next learning experience. This was true in this current research study. Learners took their observations from the digital media used to introduce Levi and his situation into the scenarios. Furthermore, they incorporated the learning from the previous scenarios into the next scenario, to build on their knowledge and experience.

7.1.2.1 Objective e), learner's behaviours

To explore and observe learner's behaviours during simulation-based education, the SPLINTS system (Mitchell et al., 2013) was utilised to structure observations, and rate the learner's actions and behaviours during each of the three scenarios. The structured observations revealed a difference in the behavioural marker scores for learners in each scenario for the overall Category scores and individual Element scores. The SPLINTS system has three Categories and nine associated Elements, scored using a four-point rating scale: 1 (poor), 2 (marginal), 3 (acceptable) or 4 (good):

- Situation Awareness Category has three Elements: Gathering information, Recognising and understanding information, and Anticipating
- Communication and Teamwork Category has three Elements: Acting assertively, Exchanging information, and Co-ordinating with others.
- The three Elements associated with Task Management Category are: Planning and preparing, Providing and maintaining standards, and Coping with pressure (Flin et al., 2010a).

Learner's performance was rated highest in the Human SP scenario, followed by the Paper-case then the Manikin scenario. However, these results were not statistically significant.

Whilst the structured observations were useful for gaining an overview of the learner's behavioural markers during simulation, the written feedback on performance was subjective and did not reveal insight into the learner's objective actions and behaviours. Therefore, a deeper analysis of the transcripts to gain an understanding of learner's behaviours during the scenarios was performed. Following extensive analysis of the transcripts, six themes were constructed from the data, related to Knowing how and when to raise concerns (Theme 1), Understanding patient's needs (Theme 2), Verbal and non-verbal communication skills (Theme 3), Uncertainty in the learning environment (Theme 4), Patient safety (Theme 5), and Engagement with the scenarios (Theme 6). These will be discussed below.

7.1.2.2 Theme 1, Knowing how and when to raise concerns

In the Manikin scenarios, half of the groups (n=2) recognised the patient's deterioration and urgently called for assistance during the scenario. The groups that recognised Levi's deterioration used a raised and assertive tone of voice to communicate their concern and need for assistance from emergency services. All four groups in the Manikin scenario also recognised their own limitations and suggested the need for a multidisciplinary team (MDT) approach, including incorporating general practitioners (GP), paramedics and speech and language therapists in the care of the patient. Analysis of the qualitative observational data collected from student learners during the Manikin scenarios revealed how half of the groups (n=2) recognised safeguarding concerns; these groups identified that the patient could not stay at home free from harm.

In the Human SP scenario, all of the groups (n=4) recognised that the patient's condition had improved and got him up out of bed to begin the rehabilitation process. Furthermore, in the Human SP scenario, all four groups carried out tasks within their scope of ability and sought support from an embedded facilitator (nurse) when needed. All four groups also recognised that Levi was well enough for rehabilitation and recognised his objective to return home.

In the Paper-case all four groups recognised that Levi required an urgent safeguarding referral. Their concern for Levi's wellbeing was revealed by the language used, their body language and shocked tone of voice, which highlighted their concern for Levi. This could have been due to the digital media used to introduce Levi and his situation to the learners, which made the paper-case seem more realistic, or could have been related to illusory truth effect, which enhanced the learner's buy-in, interest, and engagement, which will be discussed in Section 7.2. During the Paper-case, learners also mentioned that they would refer to, or seek support from, additional healthcare professionals, including social services, carers, and psychologists. All four groups (n=4) during the Paper-case recognised Levi's safeguarding concerns but did not know *how* to refer to the safeguarding team. They acknowledged their own training needs as a result of a visual cue (bruised wrists). Their lack of knowledge associated with how to raise their concerns during the Paper-case caused negative behaviours, which were depicted by learners tapping the table in a frustrated manner, and talking in a quiet, hesitant, and disjointed style.

All groups in each of the scenarios (n=12) recognised their own limitations and the need for additional support. However, in the Manikin scenario, half of the groups (n=2) did not recognise the urgency of the situation or call for emergency help. This may have been due to the high intensity of negative emotions, distraction caused by the manikin or learner's inability to buy-in to the situation because of the realism of the manikin, which impacted on the learning experience and caused knowledge to reduce post-Manikin scenario.

Theme 1, Knowing how and when to raise concerns, revealed that learner's behaviours were more negative during the Paper-case when they had no facilitator present to seek advice from. Learners recognised their own limitations and the need for assistance and support.

7.1.2.3 Theme 2, Understanding patient's needs

There was a difference in the three scenarios related to the learner's ability to recognise the patient's condition. Half of the groups (n=2) in the Manikin scenario recognised the patient was deteriorating, the other half did not understand or recognise the seriousness of his deterioration, or the implications of their in-action. This was potentially due to the fact that the patient was portrayed by a manikin, which was not as realistic as a human simulated patient. This finding could also be related to their inability to suspend disbelief, and fear-response experienced by the learners. Whilst the groups all used a patient-centred perspective, and carried out their procedural skills dutifully, they did not always respond to the patient's needs. In contrast, during the Human SP scenario, all four groups recognised the patient's condition and responded to his needs. In the Paper-case, most of learners drew conclusions from the data and discussed what they would do, however one group struggled to recognise some of the medical terms and acronyms as a result of an absence of prior theoretical knowledge or lack of support from an embedded facilitator. While all of the learners recognised and responded to Levi's situation during the Paper-case, they did not always know *how* to proceed with all of the tasks that were required of them. The lack of support from an embedded facilitator impacted on their ability to complete the scenario within the allocated timeframe.

The realism of the situation impacted on the learner's ability to perform in each of the three scenarios. The manikin's appearance, structural fidelity and the mechanical noises emitted from the manikin affected the learner's ability to complete tasks. This impacted not only on their physical response to the scenario, for example, the actions that they took and the skills they utilised, but also the theories and concepts developed as a result of the scenario (conceptual mode) and the thoughts, emotions, and beliefs about the scenario (emotional/experiential mode) (Rudolf et al., 2007). Half of the groups (n=2) during the manikin scenario considered their previous theoretical knowledge and concepts; they recognised Levi's deterioration and identified this as an emergency situation. They also drew conclusions from their own thoughts, emotions and beliefs about the situation and decided to make an urgent call for help. The other groups (n=2) had the same previous theoretical knowledge; however, they drew alternative conclusions, and decided to keep Levi at home whilst making non-urgent referrals to other healthcare professionals. Whilst this was not an incorrect action, it highlights an apparent difference in the emotional response to the scenario.

Only one of the groups (n=1) verbally stated that they found the Manikin scenario realistic, while the others seemed unable to fully engage with tasks due to the manikin's realism. Similarly, one of the groups in the Human SP scenario found it difficult to suspend disbelief and broke the realism by asking if they should pretend to have a piece of equipment, (a Zimmer frame) which they required to use as a walking aid for the patient during the scenario. However, the other three groups (n=3) suspended disbelief for the duration and did not break from their role during the Human SP scenario. Learners in the Paper-case appeared able to 'project' realism onto the paper-case, as suggested by Hamstra et al. (2014: 388). The Paper-case used narrative consistency and perceptual persuasiveness as discussed by Hall (2003) to enable the learners to become emotionally involved and connected to the character. In Hall's study (2003) to evaluate media realism related to film and television, she found that emotional involvement was enhanced by ensuring the scenarios were plausible and realistic. Despite the Paper-case being presented via text and images, learners were observed to be able to overcome the perceived lack of realism and 'buy-in' (Hamstra et al., 2014: 388) to the scenario due to the narrative consistency, plausibility, typicality and factuality of the characters and scenario and due to the established fiction contract (Hall, 2003; Dieckmann et al., 2007; Hamstra et al., 2014). This may not have been the case, had they experienced the Paper-case first; the order in which the scenarios were presented may have had an impact on their ability to establish a fiction contract. Since the learners had met Levi twice previously, they may have been better able to buy-in to the scenario despite it being unrealistic and although it was presented via written text and images.

Environmental cues were presented and recognised in each of the three scenarios. In the Manikin scenario, cues were delivered via the patient monitor to suggest the patient's deteriorating condition (his respiration rate, heart rate, temperature and blood pressure were all displayed on the monitor); other environmental cues included the patient's chest sounds, pulse and National Early Warning System (NEWS) chart. Equally during the Human SP scenario, environmental cues were delivered via the patient monitor and NEWS chart. During the Paper-case visual cues, for example, an image of Levi's bruised wrists, and text-based cues related to the patient's physiological observations were delivered via the paper-case itself. All learners recognised and responded to the environmental cues and discussed options related to the patient's needs, for example, learners discussed the need to change the patient's position, whether they should move furniture out of the way to facilitate safe transfer and discussed the patient's requirements for additional training and mental health support.

Theme 2, Understanding patient's needs, has revealed that during the Manikin scenario, although learners were presented with environmental cues, they did not always respond to them or understand the patient's needs. Furthermore, the groups in the Manikin scenario did not draw the same conclusions regarding Levi's requirements. This should be considered when facilitating simulation-based scenarios, as a facilitator should cue, prompt, and guide the learners to enable them to successfully achieve the learning outcomes. The Paper-case enabled learners to project realism due to the narrative consistency and established fiction contract. More research is required to investigate whether there was an order-effect that impacted on the learner's ability buy-in to the scenario.

7.1.2.4 Theme 3, Verbal and non-verbal communication skills

There were differences in the learner's communication skills in each of the scenarios. In the Manikin scenario, learners used assertive language and a persuasive tone of voice, three of the four groups introduced themselves to Levi and his daughter. In the Human SP scenario, again three groups introduced themselves to Levi and the nurse, however, their tone was more relaxed, and they engaged in small talk and joked with the patient. These groups in the Human SP scenarios supported each other and reassured the patient, using clear instructions and praise to encourage Levi or congratulate him when he had successfully engaged in a task. These distinct differences could be attributed to the learners 'buy-in' (Hamstra et al., 2014: 388), the acknowledgement of a fiction contract (Dieckmann et al., 2007; Rudolph et al., 2007; Tun et al., 2015) or the learner's emotional response to the scenario, which was more positive due to a human patient being embedded, rather than a manikin. The concept of 'buy-in' aligns with Goffman's (1959) theory of dramaturgy, and the associated idea of the *effectively projected* definition of the situation or *frames* (Goffman, 1959). Learners, as social actors, responded to the various situations dependent upon the realism and cues delivered. Goffman (1974) further explained these frames to include the physical framework (artifacts and natural phenomena), and the social framework (other actors present, in addition to the environmental setting). These frames provide specific rules for acting, thus explaining why learners in the current study behaved accordingly; they were simply following the rules and rituals expected of them (Barley, 2015).

Following the Human SP scenario, 9/10 of the learner's positive emotions had higher intensity, which meant their emotional state was more positive after the encounter with the Human SP. Alternatively, the communication differences could be attributed to the actual scenario content; the Manikin scenario involved Levi as his condition deteriorated, so his communication was disjointed and his breathing was laboured, whereas during the Human SP scenario, Levi's condition had improved, and he was communicating easily with the learners. Therefore, the learners may have adjusted *their* behaviours to align with the patient's presentation. In contrast, during the Paper-case the learners behaved in a thoughtful, quiet manner and there were many episodes of silence. They were seated, static, and communicated quietly together as there was no patient or distractions from technology present.

During both the Manikin and Human SP scenarios the learners used expressive touch to build a therapeutic relationship with the patient, which was not possible during the Paper-case as a physical patient was not present and physical skills were not required. Despite the patient being a manikin, learners during the Manikin scenario rubbed Levi's shoulder and his chest, using non-verbal communication skills to reassure him. Similarly, during the Human SP scenario, learners held Levi's hand and used tactile communication to reinforce their verbal communication, for example, touching Levi's leg to indicate which leg to move. Learners in both physical scenarios (Manikin and Human SP scenarios) showed examples of expressive touch, which was not differentiated by the modality, indicating that they were able to focus on psychological factors and engage with the scenarios, rather than focusing on functional or equipment fidelity (Norman et al., 2012).

Three of the four groups in the Manikin scenarios (n=3) and all four groups in the Human SP scenarios (n=4) gained consent from the patient prior to carrying out tasks. Learners all discussed consent during the Paper-case (n=4). Consent was a consistent theme in all three scenarios, regardless of the modality. None of the learners donned personal protective equipment (PPE) during the Manikins scenario, whereas most of the learners in the Human SP scenario wore PPE and washed their hands prior to interacting with Levi. This difference in behaviour may have been due to the environmental setting, which could have acted as a cue to remind learners of their responsibilities for infection control in a hospital setting.

Despite being provided with the recommended PPE in a kitbag, learners did not apply this in the home environment. It is worth noting that this research was conducted prior to the Covid-19 pandemic, hence if the research were conducted now, learners may respond differently to the scenario's cues and wear PPE in the home environment as there is now greater awareness of the use of PPE to significantly reduce the risk of infection and transmission of respiratory viruses (Cook, 2020; Mahmood et al., 2020). All learners in all three scenarios (n=12) considered Levi's comfort, needs, dignity and privacy, regardless of the modality of simulation.

Learners were presented with verbal cues in both the Manikin and Human SP scenarios. These included hints and direct questions. No verbal cues were delivered during the Paper-case, however, learners posed questions and cues for each other, as well as producing verbal responses to visual and text-based cues.

Theme 3, Verbal and non-verbal communication skills, has highlighted that communication styles differed across the three scenarios, with learners using more assertive verbal communication skills during the Manikin scenario. In contrast, learners using a relaxed and lighter tone when communicating with the Human SP and thoughtful silence during the Paper-case. Learners in both physical scenarios used non-verbal techniques, including expressive touch, to build therapeutic relationships with the patent. Learners were provided with verbal cues to assist them during the Manikin and Human SP scenarios, these were not present during the Paper-case, however, the learners would have benefitted from verbal cues to guide their learning with interacting with the text-based content in the Paper-case.

7.1.2.5 Theme 4, Uncertainty in the learning environment

In both the Manikin and Human SP scenarios, confusion was presented in two ways: firstly, the patient was sometimes *acting* confused, which was a cue to prompt the learners to respond, secondly there was *genuine* confusion felt by the learners when they were unsure of aspects of the scenario. In each of the situations whenever the learners were genuinely confused, the embedded facilitator stepped in to allay their confusion and dispel their uncertainty to facilitate the learning. There were also times during the Paper-case where the learners were confused by terminology or unsure of how to proceed. As there was no facilitator to alleviate their confusion, the learners responded by becoming exasperated and frustrated. This was presented in their body language and tone of voice. Much of this confusion was due to knowledge deficit and confidence in processes or protocols but could also have been related to cultural differences. One group comprised entirely of international students, and they struggled the most with acronyms and healthcare terminology, which are common in the United Kingdom. This should be considered when designing scenarios, to ensure the learning resources are presented in a manner that is accessible for all learners. Hamstra et al. (2014) noted that cognitive engagement was linked to higher learning outcomes. In this present research study, some learners were not able to remain cognitively engaged due to lacking the pre-requisite knowledge or nuanced linguistic registers that were required to comprehend the scenario content. This was shown to negatively affect their ability to complete certain elements of the Paper-case specifically. Negative emotions, in particular, fear, also created confusion and uncertainty in the learning environment. The additional emotional and theoretical load detracted from the learning because some learners did not possess the pre-requisite skills and were unable to process additional information. This explanation is linked to Sweller's (1988) research on the effects of cognitive load on learning. Sweller (1988) noted that additional theoretical load detracted from the learning because learners without the pre-requisite skills were unable to process more incoming information. Learners must have enough pre-requisite skills in order to benefit from simulation-based education, otherwise they may not be able to achieve their objectives and negative behaviours may ensue. Furthermore, the learners in the Paper-case scenario did not have a facilitator or other peers whom they could seek support from, which also resulted in some unprofessional behaviours.

There were some examples of miscommunication during the Manikin and Human SP scenarios, where the learners used technical terms, or did not explain their actions to Levi, prior to carrying out a task. They also used indirect instructions and some non-assertive language, which caused uncertainty for both the patient and facilitators. Again, this could be due to cognitive engagement, lack of expertise or false sense of self-efficacy. Learners tended to focus on their physical skills during the Manikin and Human SP scenarios, forfeiting their non-technical skills, for example, communication and teamworking skills. The Paper-case enabled learners to consider their actions calmly and quietly, prior to articulating them in the written action plans. However, cognitive engagement and some learner's inability to link theoretic knowledge to the patient's paper-case caused uncertainty. A clearer induction and orientation to the different learning environments, equipment, and paper case, prior to the scenarios, including an outline of expectations of the learners would have enhanced learner engagement with the tasks and reduced miscommunication and uncertainty in the learning environment (Hamstra et al., 2014).

Theme 4, Uncertainty in the learning environment, has highlighted the need for scenarios to be designed in a way that is accessible for all learners. Relevant pre-requisite knowledge and skills are also required to facilitate the completion of the scenarios, as well as an appropriate and thorough induction and orientation to the learning environment, which enhances learner engagement.

7.1.2.6 Theme 5, Patient safety

Moving and handling was recognised as an area of concern by participants in all three scenarios, regardless of the modality used to portray the scenario. When reviewing the scenarios' recorded data, queries were raised as to whether the learners would have incorrectly moved Levi in the Manikin scenario, had he been human SP. High-tech manikins are very heavy and can be difficult to move, their limbs do not move or bend in a human-like manner, they are very stiff and cannot assist in any way. Previous research *has* successfully incorporated high-tech manikins into scenarios for skills acquisition, such as basic patient moving and handing (Kiernan, 2018; Ellis and Joseph, 2021). Findings from Kiernan (2018) and Ellis and Joseph (2021) suggest that the incorrect patient handling observed during my research can be attributed to lack of knowledge and skill, rather than the equipment or modality of simulation used to portray the patient. Incorrect moving and handling skills were also observed during the Human SP scenario, which further confirms this implication. Moving and handling was discussed in relation to the Paper-case, where learners recognised patient handling as a potential training need for Alana, Levi's wife. They discussed the patient's requirements for transfer from bed-to-chair and moving around his home using walking aids. This detailed discussion cemented the learner's own knowledge of moving and handling training and education, providing opportunity for mental rehearsal, but did not enable them to practise physically. Bandura (1977a, 1977b) advocated the use of mental rehearsal and visualisation for skill development. The Paper-case was useful for this purpose; however, this would only be valuable if the learners had acquired the original skills accurately, which could then be represented visually and used for mental rehearsal (Alam et al., 2016; Eaves et al., 2016; Scott et al., 2023). Moving and handling is a required proficiency for all healthcare professionals (HCPC, 2023; NMC, 2018a). Although all pre-registration students are taught safe patient moving and handling in nursing and healthcare programmes in the United Kingdom, this area of the curriculum should be re-visited prior to any scenarios which involve the use of this set of skills in the form of pre-requisite learning, as a prebrief or media representation, which would enable learners to successfully carry out the tasks associated with these learning objectives. Thus, the pre-requisite learning would act as a 'ticket to enter the experience once preparation activities have been completed' (INACSL Standards Committee, 2021e: 11) to ensure that learners are ready and prepared for simulation. Consideration of cultural issues experienced by learners in this study reaches beyond the issues some learners experienced with terminology and skill acquisition and relates to all learners who have to develop practical or non-technical skills outside of their own prior cultural experience or competence. Learners by their very nature attend simulation-based education scenarios initially to learn and then to practise new skills; they position themselves outside of their previous cultural norms, for example, didactic classroom learning, and learn to 'act' like a healthcare professional (Talbot et al., 2010, Roberts and Talbot, 2011). Mental rehearsal, and physical participation, performing in a safe environment and linked learning activities enable learners to grow socially, culturally, and behaviourally. They take this new knowledge to future clinical practice and thereupon will enter another process of cultural redevelopment and inculcation into new environments.

Learners in all three scenarios carried out or discussed risk assessments linked to the patient scenarios. Management of risk is a key priority for pre-registration learners, and a skill that they need to gain proficiency in. Risk management features in the HCPC Standards of proficiency for physiotherapists (2023), Standard 14: Establish and maintain a safe practice environment[22], and the NMC Future nurse: Standards of proficiency for registered nurses, in particular in Platform 3: Assessing needs and planning care, Platform 6: Improving safety and quality of care and Annex B[23]: (NMC, 2018a). Simulation-based education is a useful way to enable learners to examine risk in a safe manner (Dionisi et al., 2021), prior to encountering real patient situations in practice. The systematic review by Dionisi et al. (2021) discovered that some students did not know how to deal with clinical risk to ensure the safety and quality of patient care. They also found that there is a lack of practical simulations that provide scenarios to enable learners to deal with errors, near misses or assessment of risk (Dionisi et al., 2021). This should be considered for future practice. This current research study has discovered that each of the modalities of simulation investigated (manikin-based, human SP simulation and paper-cases) are useful for enabling learners to assess and discuss risk.

Learners overcame difficulties during the scenarios by seeking help and supporting each other. Some groups of learners during the Manikin scenario (n=2) were unprepared and did not have the appropriate equipment required to carry out specific tasks. These learners modified their behaviours, showing initiative and the ability to adapt to difficult situations. Where a facilitator was present, in the Manikin and Human SP scenarios, the learners relied on them to offer support in the form of hints and cues, which enabled them to meet their learning objectives. During the Paper-case, as no facilitator was present, the learners faced difficulties, in particular with terminology or needing assistance with knowledge of safeguarding referral. The learners overcame this by turning to each other for support. As noted previously and recommended by Hamstra et al. (2014), a full induction and orientation to the environment, enabled learners to overcome difficulties and allow them to enter the learning environment fully prepared. This is further supported by the INACSL Prebriefing: Preparation and Briefing Standard, Criterion 8 (INACSL Standards Committee, 2021e), which states that facilitators should 'Conduct a structured orientation to the

[22] HCPC Standard 14.3: Work safely, including being able to select appropriate hazard control and risk management, reduction, or elimination techniques in a safe manner and in accordance with health and safety legislation.
HCPC Standard 14.5: Establish safe environments for practice, which appropriately manages risk.
[23] Annex B, Nursing Procedures, 7.1: Observe and use evidence-based risk assessment tools to determine need for support and intervention to optimise mobility and safety, and to identify and manage risk of falls using best practice risk assessment approaches (NMC, 2018a).

simulation-based learning environment including the modality' (INACSL Standards Committee, 2021e: 12) and 'Orient learners to all factors of the experience to help them achieve the objectives' (INACSL Standards Committee, 2021e: 12). The briefing should include orientation to the scenario learning objectives, equipment, manikins, or other technology-enhanced environments, embedded simulated people, the scenario setting, and any other environmental factors (INACSL Standards Committee, 2021e). Adherence with this standard would ensure that learners are fully prepared to enter the learning environment and would offer opportunity for them to seek assistance, if required, prior to entering the scenarios, which would better enable learners to overcome any difficulties encountered.

Theme 5, Patient safety, illustrated that simulation-based education is a useful tool to enable learners to assess and discuss risk management. Additionally, mental rehearsal can be used by learners to prepare for simulation-based activities, however a thorough induction and orientation to the learning environment is required prior to physical involvement in simulation.

7.1.2.7 Theme 6, Engagement with the scenarios

The Manikin and Human SP scenarios had embedded facilitators present who were actively facilitating the learning and acted in line with the five INACSL Facilitation Standard criteria (INACSL Standards Committee, 2021f). The facilitators ensured that the scenarios were structured appropriately, and they were present to guide the learners to work cohesively, to understand the learning objectives and ultimately achieve the desired learning outcomes. Embedded facilitators in the case of this research were academic educators; they had the responsibility for managing the entire simulation-based experience (INACSL Standards Committee, 2021f), with support from simulation technician colleagues. The facilitators were actively involved in role during the Manikin and Human SP scenarios, which ensured that learners were also actively engaged in the learning process. During the Paper-case, there was no facilitator embedded for the duration of the scenario. Learners were prepared and briefed in accordance with the INACSL Preparation and Briefing Standard, Criterion 8 and INACSL Facilitation Standard, Criterion 3 (INACSL Standards Committee, 2021e, 2021f), however, they were then left to complete the Paper-case alone in small groups. Cues were delivered via the case itself in the form of text and images. Learners during the Paper-case appeared to buy-into the case and treated it as if it were real, they were able to link the case to Levi and drew on their previous knowledge of the patient and his family due to the narrative consistency (Hall, 2003) and evoked context (Hein et al., 2010), proving that physical realism was not required to create a realistic learning experience. However, learners became easily distracted and sometimes acted unprofessionally, as there was no facilitator to support the learners. As stated by INACSL Standards Committee (2021f):

> 'Potential consequences of not following this standard may include impairing participants' engagement within the simulation and reducing opportunities for participants to meet the expected outcomes of the simulation-based experience'
>
> INACSL Facilitation Standard (2021f: 23).

This is further supported by Stokes-Parish et al. (2017) who claimed that if the scenario was not authentic, learners would become distracted and disengage. The need for an embedded facilitator regardless of the simulation modality is clear; to enable the learners to engage, to facilitate their learning, offer support, deliver timely cues, and overcome any uncertainty in the learning environment.

During each of the scenarios, learners carried out tasks and gathered information in the form of verbal, written and environmental data. This data and the cues the learners received pushed the scenarios forward. Their engagement with information enabled successful completion of the learning objectives. Learners preferred to be physically active, rather than writing during the scenarios and some complained of their inability to write, having relied on computers and technology for many years to type written work or save audio notes. The information that learners gathered over the course of the three weeks while they were engaged in the scenarios used for this research project influenced their behaviour and enhanced the fiction contract, facilitating the buy-in and engagement with scenarios (Hamstra et al., 2014; Tun et al., 2015). Benevolent deception, as noted by Tun et al. (2015) enhanced the learning experience during all three scenarios. The use of digital media to subtly introduce the patient and his situation ('Who is Levi Williams', Section 4.6.1) enabled the learners to become familiar with the patient. This benevolent deception tricked the learners for their benefit, so that they more effectively acquiesced to the situation and data presented. It strengthened their buy-in and created the illusion of a realistically presented scenario and thus, facilitated their learning and engagement.

Theme 6, Engagement with the scenarios, outlines the requirement for an embedded facilitator to ensure learners remain engaged with the scenario presented. The digital media used to introduce the patient and the narrative consistency threaded throughout the three scenarios enhanced the realism and the learning experience. Learners preferred to be physically active and involved in the scenarios, rather than writing their responses to the scenario.

7.1.3 Environmental factors

Environmental factors can be imposed, selected, and constructed (Bandura, 1977a). During this present research study, environmental factors relate to the modality of simulation (Manikin scenario, Human SP or Paper-case) and the subsequent realism of the scenarios. Within the scenarios themselves, learners constructed their own perception of the situation, using a constructionist approach whereby they gained meaning through social interaction with each other and the environment. The level of realism that the learners experienced during the three different scenarios had an impact on their knowledge, emotions, and behaviours. The discussion of environmental factors is related to Question 1, Is there a difference in realism between simulation modalities?

7.1.3.1 Objective a), realism of the scenarios

An adapted version of the German VR Simulation Realism Scale (Poeschl and Doering, 2013) was used to discover whether there was a difference in realism between the three different simulation modalities (Appendix E). Total simulation realism ranged from 12 (low simulation realism) to 60 (high simulation realism). The findings from this current research project revealed that there *is* a difference in realism between the modalities examined in this study. The Human SP scenario was significantly more realistic than the Manikin scenario and the Paper-case ($p<0.001$). In other words, the Human SP scenario was perceived by participants in this research study to be the most realistic modality. Whilst this is interesting, it is not surprising, given that the learners were interacting with a living, breathing, realistic human simulated patient. However, it is important to consider whether this elevated level of realism enhanced the learner's experience. Similarly, the Paper-case was perceived to be the least realistic of the three scenarios, again unsurprising as they were interacting with a written case study, which had text and images embedded; reduction in realism during the Paper-case did not inhibit the learning experience, as the Paper-case scenario provided the optimum area for learning to occur with no distractions from technology or embedded patients. Therefore, lower levels of realism did not reduce the quality of simulation-based healthcare education. The results of this research study have enabled the overarching study aim to be considered in relation to learner's personal, behavioural, and environmental factors, which are inter-related, interlocking determinants of each other (Bandura, 1977a).

Tun et al. (2015) claimed that it was not necessary to use expensive technology in the pursuit of realism. This current research supports the claim by Tun et al. (2015) as the Manikin scenario, which utilising expensive technology, was not perceived to be as realistic as the Human SP scenario. The modality of simulation, however, is dependent on the learning objectives of the scenario. If the objective is for the learner to communicate effectively, then expensive manikins are not the modality to use as they have no non-verbal communication skills, for example, they do not make eye-contact, blush, or frown. Conversely, if the objectives included the requirement to carry out an invasive procedure that would be damaging to a human SP, then manikin-based simulation would be advocated. Schaumberg (2015) found that there was no evidence to suggest how much learners should be stressed in order to achieve learning outcomes, nor was there any evidence to suggest a correlation between simulation realism and learning effectiveness. Schaumberg (2015) asked the question 'How much realism must be sought to achieve a particular learning outcome?' (Schaumberg, 2015: 22). The current study supports this evidence; learning outcomes were achieved by learners in each of the three scenarios, regardless of the modality or level of realism. The study aim related to realism will be explored further, with the intention of discovering whether simulation modalities with differing levels of realism impact learner's knowledge, emotions, and behaviours.

Media used to introduce the patient, Levi, his situation, and context enabled learners to become emotionally involved and connect with the patient (Hall, 2003). This was apparent in the Paper-case. The narrative consistency and visuals created perceptual persuasiveness in the phenomenal (emotional and experiential) mode (Dieckmann et al., 2007; Rudolf et al., 2007), further supporting Tun et al. (2015) who claimed that expensive technology was not required in the pursuit of realism. The Paper-case highlighted learner's ability to buy-in to the scenario due to their ability to 'project' realism onto the paper case study (Hamstra et al., 2014: 388). The digital media used to introduce the patient and his family enabled learners to develop a visual image of Levi despite the Paper-case having low structural fidelity (Hamstra et al., 2014). They were not distracted by a manikin or human SP, so entered the optimum area and were able to learn more following the Paper-case than the other two scenarios. This current study supports the use of digital media to enable learners to connect with the people embedded into scenarios, regardless of whether they are a human, manikin or presented via a paper-case study.

The method of developing comprehensive person profiles is used as a technique to train people to become simulated people (patients, relatives, healthcare professionals) in the established Simulated Patient Programme (Gough et al., 2015; Greene and Gough, 2016). The Train-The-Simulated-Patient (2TSP) project provided the first regional, standardised, quality assured approach to training Simulated Patients in the United Kingdom. A novel aspect of this project was that it embedded performing arts pedagogy within the 2TSP blended learning programme, which comprises e-learning and one face-to-face workshop. The pedagogy includes applied theatre practice, process drama, improvisation, and role-play. The 2TSP programme involves the following teaching styles and techniques:

- Forum Theatre (Boal, 1993; 1994)
- Character development strategies including hot-seating, analysis of body language, tone of voice, dialogue, and facial expressions (Stanislavski, 1949; 1961)
- Role-playing including the following strategies: Flash-back/Flash-forward, Marking the Moment, Image Theatre and Thought Tracking (Taylor and Leeder, 2001; Flemming, 2003; Neelands and Dobson, 2005)
- Utilisation of the Stanislavski System (Stanislavski, 1936; 1949; 1961) particularly exploring The Magic 'If', observation, motivation, and emotional memory.

The PrOPS process developed by Gibson (2015), was integrated within the 2TSP programme (Figure 7-1). The PrOPS process relates to the development of a character, including the role profile, the person's objectives, how they present themselves physically and how the person speaks. The PrOPS process blends the above performing arts pedagogies to enhance characterisation development and role portrayal in non-arts settings (Gibson, 2015).

Figure 7-1: The PrOPS process.
(Copyright: Gibson (2015) image reproduced with permission; all rights reserved)

The development of the person profile is the starting point for character development. Once the profile is formulated, it can be developed further into digital media to present the character, which enhances learner's buy-in and strengthens the fiction contract. This strategy is also used in the Virtual Community, Birley Place, which was discussed in Chapter 1, Section 1.2.1.

Birley Place combines people, places, and scenarios in an interactive website, and is used for health and social care education (Greene et al., 2020; Wright et al., 2021). The fictional neighbourhoods in Birley Place are represented on a map (shown in Figure 7-2A). Real census and health and social care data were used to create simulated neighbourhood profile documents containing statistical health and population data for each neighbourhood (Figure 7-2B) which model distinct real-world areas. Realistic representations of the housing, businesses, and health and social care services that exist in real-world areas are also embedded into the neighbourhoods (Figure 7-2C). The virtual people within the community simulate relatives, neighbours, colleagues, and friends who interconnect with each other, enabling family groups and social networks to be characterised. The interactive map can be used for teaching and learning, enabling learners to engage with the community, for example, by clicking on the map to visit buildings or to access information about the people who live or work there. Background information is provided for each person in the form of a role profile, containing details about their personality, age, occupation, hobbies, and lifestyle (Figure 7-2D). This creates a rich pool of media to present the characters and people living in the virtual community. Narrative is used to present information on the situations, contexts, or scenarios the people find themselves in (Figure 7-2E). These scenarios can be simple or complex with text, images, audio, and video with in-built decision making. Birley place can be used by individuals or in a classroom-based situation and is useful for prebrief; to enable learners to get to know the people they may meet in physical simulation scenarios, but also post-physical simulation for reflective learning, to present interactive linked-learning activities or for virtual repetition of scenarios to enable post-event repetition and mastery learning of the scenarios, which will ultimately enhance the experience for learners.

Figure 7-2: Birley Place map (A), neighbourhood data (B), place (C), person profile (D) and scenario (E) (Image from Wright et al. (2021), reproduced with permission)

7.2 Study limitations

As with any research project, there are associated limitations that can affect the results, and these will now be considered. The group of learners who were invited to participate in this research were selected purposefully as they had not experienced simulation-based education previously and therefore, had no preconceived ideas or thoughts related to it. However, in order to enable their participation, the data collection was incorporated into the student's timetabled simulation activities, meaning that they attended specific simulation-based education sessions over a three-week period. Learners may have felt compelled to take part, however, this was mitigated by the ethics of care as a moral theory that was embedded into the design of the study. Furthermore, due to the methods used to embed the patient at the heart of simulation activities and the way in which simulation is conducted and embedded into the curriculum at the institution where I carried out my research, learners met the same patient in different contexts each week. This meant that learners could have experienced a repeat effect whereby they carried observed behaviours from one scenario (week 1, Manikin scenario) to the subsequent scenarios (week 2, Human SP scenario and week 3, Paper-case). This repeat effect potentially led to an illusory truth effect, where repetition increased the perceived truth (Hassan and Barber, 2021). This is related to exposure to the same patient (Levi) over the three weeks. In other words, 'the more frequently information is encountered, the more truthful that information is perceived to be' (Hassan and Barber, 2021: 8). Whilst the illusory truth appeared to have a positive impact; it enhanced the learner's buy-in, interest, and engagement with the scenarios, the repetition and continuation of Levi's story and his progression over time may also have affected learner's beliefs about the truthfulness of the situation. This repeat effect may have affected the data associated with Question 1 (realism), Question 2 (knowledge), Question 4 (emotions) and Question 5 (behaviours) related to the scenarios. In order to test this theory, the same simulation modalities would need to be analysed with different patients embedded into the scenarios, to appreciate the impact of the illusory truth effect.

Order effects may also have affected the results of my research. These are changes in participants' performance due to repeating the same or similar tests or scenarios more than once. This is in addition to the repeat effect and the impact of illusory truth. Examples of order effects include practice effect, which is an improvement in performance on a task due to repetition. This improvement in performance can be due to familiarity with the task or situation (Mcleod, 2023). Order effect could have been overcome by alternating the order in which participants experienced the scenarios. For example, the Paper-case may not have been so impactful, perceived to be as realistic and generated such a heightened emotional response to the bruising on Levi's wrists, if it had been experienced first, prior to learners becoming familiar with Levi and his situation. In order to appraise the impact of order and practice effects, the scenarios would need to be examined in a randomised order.

This observational cohort study was undertaken in one institution, with a relatively small sample size of pre-registration Masters (Level 7) Physiotherapy students. The nature of mixed methods research facilitated the gathering of both primary data to quantify the effect of realism on learner's knowledge, emotions, and self-efficacy, it also enabled an in-depth exploration of learner's actions and behaviours during simulation. There may, however, have been more power in the data if more student learners had participated. Further, exploring the effect of realism on other student cohorts would be advantageous, for example, investigating undergraduate students (Level 4, 5 and 6) and students from different programmes of study, for example, nutrition, dietetics, speech and language therapy, radiography, occupational therapy to name a few. Due to the nature of the timetabling for the student learners who participated, data collection was completed within a given three-week timescale. Additional participants from different subject areas would have added depth to the understanding of the scenarios, but the limitation linked to room availability and timetabling meant that this was not possible.

Whilst I considered the detached observation of participants to be a strength of this research, it would have been valuable to interview students individually or via focus groups to gain additional insight into their personal thoughts and feelings related to the impact of realism on engagement and emotional response. In addition to observing *what* they did, this would have presented insight into *why* they behaved in certain ways. Furthermore, interviewing may have mobilised greater and more subtle knowledge and understanding of the cultural positioning of students within this kind of learning. Culture was acknowledged in the findings as having an impact on both the engagement with scenarios, learner's knowledge, and behavioural factors.

There are benefits to working as an insider conducting research in the institution where one is also employed, for example, an insider-researcher has expertise and experience that can lead to an ‘advanced level of knowledge of issues in your area of practice’ (Costley et al., 2010: 6). In addition, insider researchers can navigate around systems and practices with ‘creativity and ingenuity’ (Costley et al., 2010: 7). Nixon et al. (2008) also suggested that undertaking insider-led research can make significant contributions to work-place practices. However, there are some limitations to insider-research. Only ‘fuzzy generalizations’ (Bassey, 1999: 12) can be made, this means that the findings may have some general application in a similar context, but wider generalisations cannot be made to the wider student population involved in simulation-based education. There may also be conflicts of interest between student learners, the researcher and organization, which may affect the truthfulness of the data. The objectivity of the researcher may also be compromised, and, in the case of this research study, student learners may have acted differently due to ‘fake’ professional behaviours (Goldie, 2013: e953); meaning the data may not be a true representation of their actual knowledge, self-efficacy, emotions and behaviours.

Some of the items in the adapted realism scale may have been deemed not applicable to the Paper-case, which included text and images describing the scenario and simulated patient. For example, Item 9, *Outfit of simulated patients was natural,* and Item 10, *Outfit of simulated patients was adequate* may have been irrelevant to the Paper-case. In these instances, participants were able to strongly disagree (score 1) or disagree (score 2) with these statements, which potentially skewed the results, making the Paper-case appear less realistic than the other two scenarios. Finally, the small size of the cohort observed during my research, their age, gender and prior academic success and potential for a false sense of self-efficacy (Pike and O’Donnell, 2010) means the results of this study may not be transferrable to other cohorts, for example pre-registration student learners. In addition, the sensitivity of the General Self-Efficacy Scale (GSES) (Schwarzer and Jerusalem, 1995) may not have detected precise differences in learner’s self-efficacy between modalities, nor may it have been specific enough to enable learners to relate their self-efficacy beliefs to the situation or context they were about to experience. In other words, it may have been too general.

7.3 Chapter summary

This current research has highlighted the positive use of digital media to introduce simulated people, as this enhances the learner's buy-in and strengthens the fiction contract between facilitators and learners (Dieckmann et al., 2007). Regardless of the environment in which the scenarios were presented, the realism or the modality of simulation, learners were able to connect with the patient holistically; a photograph of Levi's bruised wrists generated an emotional response from learners who were concerned for his welfare and sparked discussion around safeguarding, risk, and safety. This study has discovered that digital media can be used to enhance the phenomenal mode, relating to learner's thoughts, emotions, and beliefs. A summary of the study findings can be found in Table 7-3 below.

Table 7-3: Summary of overall findings

Realism	Human SP scenario was perceived by participants in this research study to be the most realistic modality. Nonetheless, lower levels of realism did not reduce the quality of simulation-based healthcare education; the Paper-case was perceived to be the least realistic yet provided the optimum area for learning to occur with no distractions from technology or embedded patients. Learners have the ability to 'project' realism onto scenarios; digital media should be used to aid learners to establish a fiction contract, therefore enabling them to connect with the simulated people embedded into scenarios.
Knowledge	Learners had significantly more post-scenario knowledge after participating in the Human SP scenario and the Paper-case. Learners gained significantly more pre-to-post knowledge after participating in the scenario with an embedded human SP.
Self-efficacy	There was no difference in learner's self-reported general self-efficacy between the three scenarios. All learners reported high levels of general self-efficacy prior to each of the scenarios. These high self-efficacy beliefs led to improved performance but may have been due to a false sense of efficacy. Nevertheless, learners modified their behaviours so that they could overcome negative emotions and meet the learning outcomes.

Emotions	Positive emotions had higher intensity than negative emotions in all three scenarios. Interest had the highest intensity of all the positive emotions experienced by learners and fear had the highest intensity of all the negative emotions. Interactions with a Human SP had a positive impact on learner's emotions. Learners felt more negative after the Manikin scenario. The overall negative emotions experienced by learners during the Paper-case, were less intense than the two physical simulation scenarios.
Behaviours	<u>Theme 1</u>, Knowing how and when to raise concerns, revealed that learner's behaviours were more negative during the Paper-case when they had no facilitator present to seek advice from. Learners recognised their own limitations and the need for assistance and support.
	<u>Theme 2</u>, Understanding patient's needs, revealed that during the Manikin scenario, although learners were presented with environmental cues, they did not always respond to them or understand the patient's needs. The Paper-case enabled learners to project realism due to the narrative consistency and established fiction contract.
	<u>Theme 3</u>, Verbal and non-verbal communication skills, highlighted that communication styles differed across the three scenarios, with learners using more assertive verbal communication skills during the Manikin scenario, a relaxed and lighter tone when communicating with the Human SP and thoughtful silence during the Paper-case. Learners in both physical scenarios used non-verbal techniques, including expressive touch, to build therapeutic relationships with the patent. During the Paper-case learners would have benefitted from verbal cues to guide their learning when interacting with the text-based content in the Paper-case.
	<u>Theme 4</u>, Uncertainty in the learning environment, suggested the need for scenarios to be designed in a way that is accessible for all learners. Relevant pre-requisite knowledge and skills are also required to facilitate the completion of the scenarios, as well as an appropriate and thorough induction and orientation to the learning environment, which enhances learner engagement.

Theme 5, Patient safety, illustrated that simulation-based education is a useful tool to enable learners to assess and discuss risk management. Mental rehearsal can be used by learners to prepare for simulation-based activities.
Theme 6, Engagement with the scenarios, outlines the requirement for an embedded facilitator to ensure learners remain engaged with the scenario. The digital media used to introduce the patient and narrative consistency threaded throughout the three scenarios enhanced the realism and the learning experience. Learners preferred to be physically active and involved in the scenarios, rather than writing their responses to scenarios.

CHAPTER 8 - CONCLUSION AND RECOMMENDATIONS

8.0 Chapter overview

To conclude, a conceptual framework infographic, which illustrates and explains the interrelationships between the study findings, is presented. Following this, recommendations for policy, practice, and future research are outlined. Finally, an epilogue draws the thesis to a close, which poses an exciting and challenging future vision for simulation-based healthcare education.

8.1 Development of a conceptual framework

To combine my findings with existing theory, evidence and best practice and illustrate the parts, players, and processes involved in simulation-based education, I have developed a conceptual framework infographic (Figure 8-1). The conceptual framework incorporates terminology, process, and best practice from the INACSL standards (2021a, 2021c) related to scenario design, prebrief, scenario delivery and debrief following simulation-based education. The conceptual framework builds on the ISTEL Framework (Gough et al. 2016a and 2016b); it embeds the learner at the heart of the map, in the same way that the ISTEL Framework begins in the Preparation phase with Learner, followed by Facilitator, however the new conceptual framework shows the strength of the relationship between the learner and facilitator and highlights the need for facilitators to be present, to offer support and deliver cues during simulation-based education. Further best evidence included from the ISTEL Framework is demonstrated by the inclusion of post-event reflections and 'linked learning activities' (Gough et al., 2016a: 4), which Gough et al. (2016a) states can include reflective journals, e-portfolios, future clinical practice, and additional simulation-based education scenarios. The new conceptual framework demonstrates the inter-relationships between systems and sub-systems related to simulation-based education. This infographic has been developed with support from ecological systems theory (Bronfenbrenner, 1979). Eco-system mapping enables visualisation of the inter-relationships between people, systems, and contexts (Darling, 2007). Brofenbrenner's (1979) ecological mapping was selected as an appropriate tool for depicting the results of this study because it supports the notion of the learner at the heart of the scenario and aligns closely with the ethics of care (Held, 2006) and Healthcare Simulationist Code of Ethics (Park et al., 2018) as discussed in Chapter 3, Sections 3.6.2 and 3.6.3. As Darling (2007) explains, at the heart of any eco-system map firmly lies the 'active person' (Darling, 2007: 204); 'shaping environments, evoking responses from them, and reacting to them' (Darling, 2007: 204). Similarly, during my study, the learners were at the heart of the research, it was conducted with them in mind, to improve and enhance their experiences and shape the way in which simulation-based education is carried out in the future. Darling also explains that 'different environments will have different affordances and will be responded to in different ways by different individuals' (Darling, 2007: 204). This further supports my suggestion that the level of realism experienced during different simulation scenarios (the environment) impact upon learners, and that learners can, and do, respond differently to the ways in which scenarios are presented to them.

The infographic depicts the learner at the centre of a series of concentric circles, that represent the techno-subsystem (Johnson and Puplampu, 2008), which is a dimension of the micro-system; the micro-system itself; the exo-system, and the macro-system. The original Jeffries Simulation Framework (2005) was critiqued by LaFond and Van Hulle Vincent (2013); they made a number of recommendations, including the need for studies that consider the relationships between concepts. They particularly mentioned the need for studies that investigate the relationship between facilitators and learners:

> 'Additional studies are necessary to establish relationships among concepts and the associated concept variables in the framework; specifically needing further investigation are the teacher and student concepts' (LaFond and Van Hulle Vincent, 2013: 478)

LaFond and Van Hulle Vincent's (2013) critique further stated that studies outside of the USA were required and studies that went beyond exploration of student perceptions of self-confidence and satisfaction were also necessary. Hence supporting this current research, which was outside of the USA and explored learners' knowledge, emotions, and behaviours, rather than self-confidence and satisfaction.

Further critique of the NLN/Jeffries Simulation Theory (2015) by Cowperthwait (2020) suggested modifications and new additions to the Theory to integrate best practice when working with human simulated participants. It is clear that, as simulation-based education evolves and advances, the NLN/Jeffries Simulation Theory (2015) will further develop. For example, the Jeffries Simulation Framework (2005) terminology was changed in the updated NLN/Jeffries Simulation Theory (2015) to remove *Teacher* and *Student*, which were replaced with *Facilitator* and *Participant*. However, within the Design Characteristics, the NLN/Jeffries Simulation Theory (2015) still refers to 'physical and conceptual fidelity' (Jeffries et al., 2015: 292), despite Hamstra et al's. (2014) recommendation that the term 'fidelity' in simulation-based education be abandoned altogether, favouring terms that better describe physical resemblance and functional task alignment. Therefore, the new conceptual framework suggested as a result of this current research (Figure 8-1) advances the NLN/Jeffries Simulation Theory (2015) by using up-to-date terminology and highlights the changing requirements of learners and facilitators to engage with innovative technology and digital media. The new conceptual framework includes a novel techno-subsystem, which is a concept proposed by Johnson and Puplampu (2008), and further expanded by Johnson (2010) in response to the 'dramatic increase' in the use of digital technologies (Johnson, 2010: 285). The techno-subsystem can include, for example, learner's interaction with mobile phones, television, e-books, software, and the internet. In this study specifically, the techno-subsystem refers to learner's interactions with equipment, technology and digital media that was used to introduce the patient who was embedded into each of the three scenarios they experienced. The micro-system or direct environments refers to the different modalities of simulation. In this case, the different modalities experienced by learners were, manikin-based simulation, simulation with an embedded human simulated patient and a paper case study. The exo-system includes the indirect environments, which relate to the pre-learning/prebrief, scenario delivery, debrief, post-event reflections and any linked learning activities that follow the scenarios. The macro-system denotes the 'overarching social ideologies and cultural values' (Johnson, 2010: 284). In this present study, the macro-system refers to behavioural factors, for example, the learner's emotional and physical responses to the environments, plus their cultural differences, which was acknowledged in the findings of this current study as having an impact on the engagement with scenarios. Cultural behavioural factors have been included in the conceptual framework to highlight the need for simulation scenarios that are accessible for all learners. The macro-system is associated with the characteristics of the learner at the heart of the system. These characteristics evoke different responses to the environments and induce different reactions to it. These characteristics include the learner’s demographics, previous knowledge, experience, and their own self-efficacy beliefs.

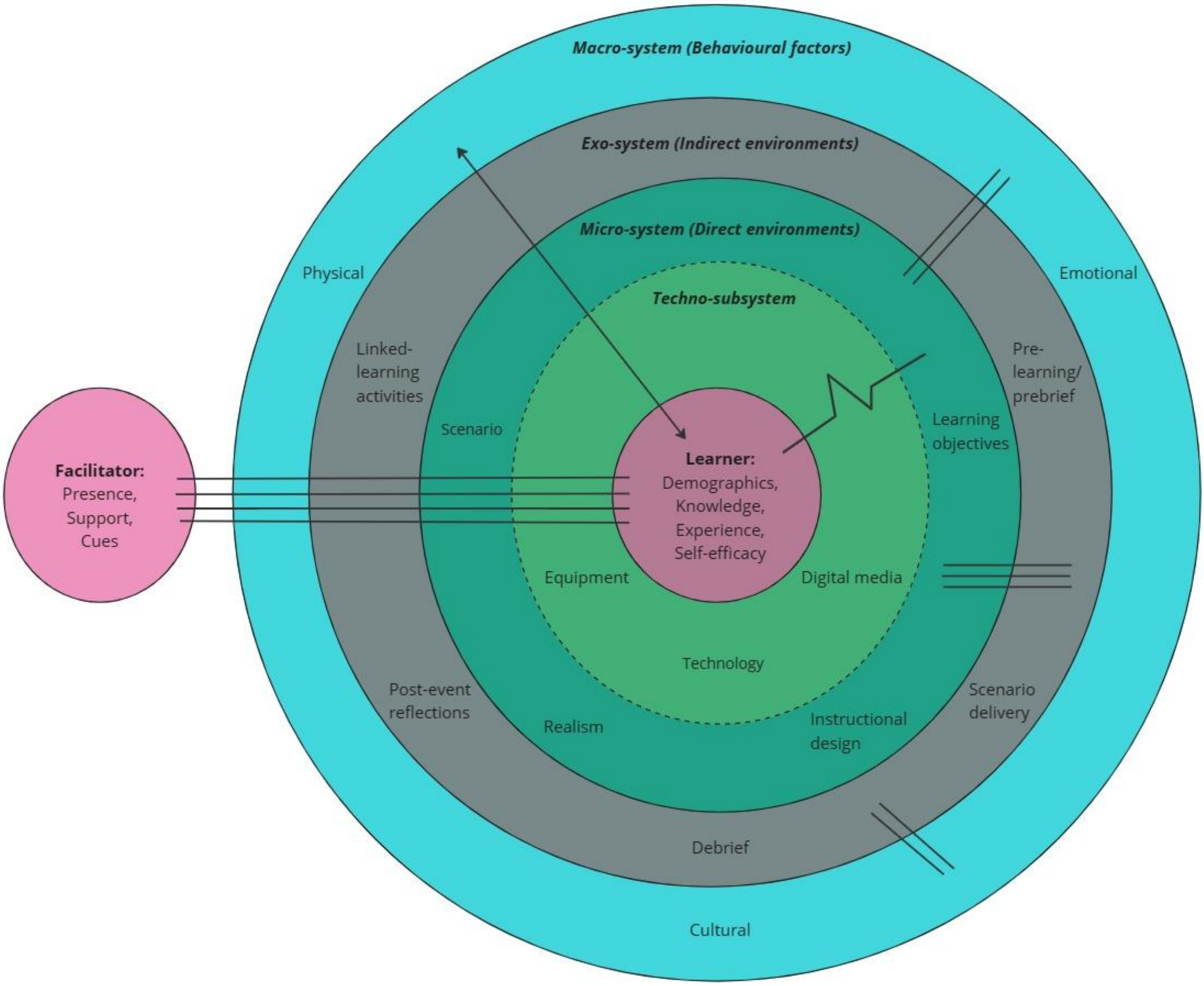
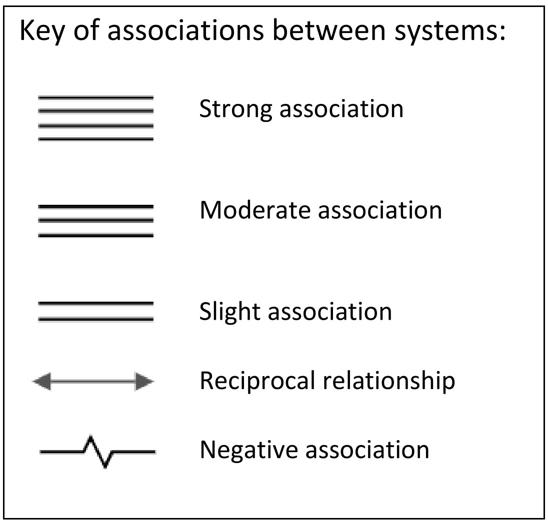


Figure 8-1: Conceptual framework depicting the inter-relationships between systems and sub-systems



The key above explains the inter-relationships shown in Figure 8-1. Drawing on LaFond and Van Hulle Vincent's (2013) recommendation to establish relationships among concepts, the new conceptual framework (Figure 8-1) demonstrates the strength of associations between systems. The facilitator is strongly associated with the learner at the heart of each scenario. Regardless of the modality of simulation or the direct environment, it is imperative that a facilitator is present, to support the learners and provide cues that will enable them to meet the learning objectives. There is a moderate association between the micro-system, including the dimensions of the techno-subsystem, and the exo-system. This explains the connections between the digital media used to introduce Levi, that was threaded throughout each of the scenarios. This media, which included audio, video, and images, enabled the learners to buy-in to the scenarios and project realism onto unrealistic situations. In the future, the techno-subsystem may extend beyond audio and video data, and include additional digital technologies, for example, interaction with virtual communities, virtual and augmented reality, holograms, and artificially intelligent avatars.

The direct and indirect environments are inter-related; the modality of simulation or realism required and, therefore, the learning objectives and instructional design applied to the scenario is dependent on the type of pre-learning, scenario delivery, debrief, post-event reflections and any linked learning activities that follow. For example, if one requires learners to increase knowledge, then a paper-case is the suggested modality. If one requires learners to react to the situation with positive emotions, and use positive communication and behaviours, then a scenario with an embedded human SP would be the preferred modality.

There are slight associations between the macro-system and the exo-system; indirect environments (pre-learning, scenario delivery, debrief, post-event reflections and linked learning activities) impact on learner's behavioural factors. Providing a thorough prebrief and orientation to the environment impacts positively on learner's behaviours. Furthermore, there is a slight association between the macro-system and the micro-system; direct environments (simulation modalities) impact on learner's behavioural factors, which can be emotional, cultural, or physical, represented by what the learners *do* or how they behave within the environment.

There is a negative association also noted between the micro-system and the learner; the learning objectives, instructional design, depicted realism and scenario itself can negatively impact on learner's knowledge, experience and self-efficacy and their ability to learn during simulation-based education. Since there is a reciprocal relationship between the learner and the macro-system, then this indicates that the negative associations induced by the micro-system (including simulation realism) can negatively impact the macro-system, translating to a negative impact on learner's behavioural factors (their emotional and physical response to scenarios). Furthermore, cultural differences exposed in the macro-system are mutually linked to learner's knowledge, experience, and self-efficacy.

To ensure a positive learning experience during simulation-based education, simulationists, facilitators and scenario designers should consider the inter-relationships between the macro-, exo- and micro-systems, as well as the techno-subsystem, always with the learners and their needs at the heart of everything that we do.

8.2 Recommendations for policy, practice, and future research

This research is the first mixed methods observational cohort study to explore the effect of realism on undergraduate student learner's engagement and emotional response during simulation-based education. Based on my findings, the following recommendations for future simulation-based education policy, practice, and research have been developed (Table 8-1).

Table 8-1: Recommendations for policy, practice, and future research

Policy	**A greater appreciation of the *impact* of realism on learner's engagement and emotional response. Policy recommendations include:** • To ensure a positive learning experience during simulation-based education, simulationists, facilitators and scenario designers should consider the inter-relationships between the macro-, exo- and micro-systems, as well as the techno-subsystem, with the learners and their needs at the heart of everything that we do. • Human simulated patients enhance the realism during simulation-based education; they aid knowledge gain and create a positive learning experience, resulting in positive emotions and behaviours. Human simulated patients should be embedded into simulation-based education wherever possible. • Manikins should only be used when aligned to specific learning objectives, or when a procedure would be damaging to a human simulated patient. • It is not necessary to use expensive technology in the pursuit of realism. • Digital media should be used to assist learners to establish a fiction contract, which enables them to connect with the simulated people embedded into scenarios.

Practice	**The following recommendations for educators involved in simulation-based education, to enhance the experience for learners:** • Always embed a facilitator regardless of the simulation modality; to enable the learners to engage, to facilitate their learning, offer support, deliver timely cues, and overcome any uncertainty in the learning environment. • Align the simulation modality to the scenario learning objectives: if the objective is for the learner to communicate effectively, then expensive high-tech manikins are not the modality to use as they have no non-verbal communication skills. If the objectives included the requirement to carry out an invasive procedure that would be damaging to a human SP, then manikin-based simulation would be advocated. • Embed digital media and detailed role profiles to introduce the patient embedded in any scenario, which will assist learners to 'project' realism onto scenarios; digital media should be used to aid learners to establish a fiction contract, therefore enabling them to connect with the simulated people embedded into scenarios. • Ensure consistency of simulated people embedded into scenarios, for example, by the use of a virtual community, to enhance the realism, buy-in, and interest during simulation-based education. • Paper-cases are a valid and valuable modality for simulation-based education; they enable the enhancement of knowledge. Paper-cases are advocated for prebriefing, and post-physical simulation activities to cement the learning and facilitate post-event reflections and provide opportunities for linked learning activities.

Future research	**Recommendations for future research to advance and enhance this current study:** • Further research is required to investigate whether there was an order-effect that impacted on the learner's ability to buy-in to the scenario. The scenarios would need to be examined in a randomised order; therefore, a randomised cross-over trial is suggested. • The same simulation modalities would need to be analysed without the same patient embedded into the scenarios, to appreciate the impact of the repeat effect, whereby learners carried observed behaviours from one scenario to the next, and the illusory truth effect. • A qualitative study (interviews or focus groups) is desirable to gain additional insight into learners' personal thoughts and feelings related to the effect of realism on engagement and emotional response during simulation-based education. This would present insight into why they behaved in certain ways. • Development of a simulation-specific self-efficacy scale is required to truly understand the impact of different simulation modalities on learner's self-efficacy. The GSES was too general to detect differences across simulation modalities, so a more sensitive scale is required. • Exploration of the effect of realism on other student cohorts, for example, undergraduate students (Level 4, 5 and 6) and students from different programmes of study to generate more transferrable data. • A large cohort study involving pre-registration learners from other healthcare-related programmes of study to enable greater generalisation of the findings. • Culture was acknowledged in the findings as having an impact on both the engagement with scenarios, learner's knowledge, and behavioural factors. More research is required to gain greater and nuanced knowledge and understanding of the impact of cultural differences on the ability to learn and perform during simulation-based education. • Further analysis of the impact of engagement with the future techno-subsystem involving innovative simulation modalities, including virtual and augmented reality, AI and virtual avatars is vital. This is due to the diffusion of innovation, the acceptance and uptake of novel simulation modalities, technological advancements, and accessibility of alternative methods for simulation delivery.

8.3 Conclusion

This research has highlighted the impact of simulation-based education scenarios with different levels of perceived realism on student learners. Specifically, it has shed light on the impact of simulation modalities with different levels of realism on learner's knowledge, emotions, and behaviours. More research is required to fully appreciate the impact of simulation on learner's self-efficacy as all the learners in this study reported high self-efficacy prior to engaging with the different simulation scenarios. Questions have been raised as to the need for a simulation-specific self-efficacy scale to overcome difficulties associated with false self-efficacy, which has been highlighted in the recommendations for future research (Table 8-1).

The Human SP scenario was perceived to be the most realistic modality; this realism enhanced the learner's experience, producing a significant knowledge gain, positive emotional response, and positive behaviours. The Paper-case was perceived to be the least realistic; however, this did not inhibit the learning experience, as learners gained the highest post-knowledge scores following interaction with the Paper-case, which was due to the lack of distraction creating an optimum area for learning. The Manikin scenario was perceived to be not as realistic as the Human SP scenario, it produced a negative emotional response and more negative behaviours, however, manikin-based simulation is necessary in some instances for certain procedural simulation scenarios that may be harmful to a human simulated patient. This should be considered when making decisions about the modality of simulation-based education prior to the scenario design process.

Careful consideration needs to be taken when designing simulation-based activities and scenarios, to ensure the correct modality is used to enable learners to perform in a way that supports them to learn effectively and achieve the desired learning outcomes. With that in mind, trained facilitators should always be embedded to offer support, overcome fears and uncertainty in the learning environment, and offer appropriate verbal and environmental cues to learners. A facilitatory approach, combined with an appreciation and acknowledgement of the potential for learners to experience negative emotions during simulation scenarios that can adversely impact on their learning, will provide a positive environment for learning, and improve the quality of simulation-based healthcare education. This will lead to positive emotions and behaviours resulting in deeper learning.

A conceptual framework infographic (Figure 8-1) has been presented. This figure illustrates the findings of this research, highlighting the complexities and inter-relationships of the interconnected systems involved in simulation-based education. The conceptual framework and findings from this study aim to support future simulation-based education by guiding the design and delivery of effective learning experiences with the learners' needs at the heart of the scenarios.

EPILOGUE

In 2004, Gaba wrote *The Future Vision of Simulation in Healthcare*, which was reprinted in The Journal of the Society for Simulation in Healthcare (Gaba, 2007). This paper described two possible scenarios for how simulation-based education might play out by the year 2025. The first is an optimistic view, where simulation has been a successfully integrated throughout the fabric of healthcare, where 'physicians, nurses, and allied health personnel were trained together in the classroom, in frequent and diverse simulations' (Gaba, 2004: i7). The second scenario proposed by Gaba (2004) is a pessimistic view of 2025, where simulation is used intermittently, it never caught on widely, and made no impact on the delivery of care, in short, simulation is a 'dismal failure' (Gaba, 2004: i8). We are currently in the year 2023, two years away from Gaba's future vision projections, and at an appropriate stage to reflect on the direction of simulation-based education. Projecting forward two years, one must consider whether simulation will be embedded continuously into all fields of healthcare education or will it be used sporadically, haphazardly, and disproportionately across healthcare education programmes. The future vision of simulation proposed by Gaba in 2004 did not account for a global pandemic, which accelerated the use of technology and alternative means for communication and education. Nor did it predict developments in technology so advanced that individuals can remain connected to the Internet of Things (IoT) 24 hours a day. From smart watches that monitor your personal health data, to smart plugs that control your ambient lighting, to sensor-equipped mugs that provide hydration data[24] to carers, the world is changing and so is simulation.

In 2017, when I collected my project data, the use of digital media to introduce learners to a patient prior to a scenario was an advanced method. Nowadays, this data is presented via different means, for example, virtual avatars in a virtual community. In the future, these avatars will integrate artificial intelligence (AI) and provide realistic, real-time personification of humans. Communication skills training can already be experienced via computer platforms, which offer some level of artificially intelligent interactivity[25]. Chat

[24] Smart mug, available here: https://www.miicare.co.uk/products

[25] SimConverse (https://www.simconverse.com/) provides cutting-edge AI communication training.

GPT[26], a Generative Pre-trained Transformer (GPT) (OpenAI.com, 2023) has been widely discussed recently in the press[27] (Shearing and McCallum, 2023). Chat GPT is an advanced language model developed by OpenAI: it purports to have a deep understanding of human language and can answer text-based questions, provide explanations, engage in discussions, and offer assistance on a wide range of topics (OpenAI.com, 2023). AI has the potential to significantly change the world, particularly in healthcare. AI may revolutionise healthcare by assisting in disease diagnosis, drug discovery, personalised medicine and by analysing large amounts of medical data to provide valuable insight, leading to improved patient care and outcomes (or so Chat GPT told me when I asked!). However, already academics are publishing evidence supporting the potential use of advanced language models, like Chat GPT, in healthcare, for example, Korngiebel and Mooney (2021), who considered the opportunities and threats of GPT in healthcare, Biswas (2023) who discussed the role of Chat GPT in public health and Arslan (2023), who explored the potential for Chat GPT in obesity treatment, to name a few. The future is changing and simulationists need to be ready.

Our future does not necessarily look like the future vision Gaba (2004) proposed; it contains artificial intelligence, virtual avatars, digital MetaHumans[28] (Figure 8-3) and alternative equipment, platforms and technologies including virtual, augmented, and mixed realities. Simulation is not yet successfully integrated throughout the fabric of healthcare education, nor is it a dismal failure. It is an intermediate, somewhere between the two. The future vision is both exciting and challenging; it offers opportunities we could never have dreamt of twenty years ago. In order to be prepared for *our* future, we need to ensure that we get the fundamentals of simulation in healthcare education correct. This means that we should look to the evidence base and always consider the safety of student learners, regardless of the modality of simulation. Facilitators need to be trained in the theory and educational practices related to simulation, skilled in appropriate scenario design, and educated and skilled in debriefing learners following every scenario, to enable deep reflection and

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[26] I asked ChatGPT the following questions '*Can you tell me what Chat GPT is*?' and '*Is AI going to change the world?*' some of the data it generated in response to my questions has been included in my explanation above (Chat GPT is powered by OpenAI's language model, GPT-3.5; http://openai.com)
[27]ChatGPT: Can students pass using AI tools at university? https://www.bbc.co.uk/news/education-65316283
[28] https://www.unrealengine.com/en-US/metahuman

application to theory and future practice. Human simulated patients need to be supported and trained using robust, standardised programmes, and treated equitably. Technicians need to be trained in the same way, so that their role portrayal, where manikins are utilised, is realistic, appropriate, and believable. Terminology should be standardised, so we are all using the same language and simulation standards, for example, the INACSL Standards (INACSL Standards Committee, 2021d), should be widely utilised, integrated and adhered to. Once we have these foundations in place, we will be ready for the future and the excitement that it holds.

Figure 8-2: The future Levi Williams
Image created using MetaHuman Developer (Unrealengine.com, 2023)

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APPENDICES

Appendix A: Glossary of terms

Appendix B: Literature table

Appendix C: Ethical approval memo

Appendix D: Appraisal of structured observation tools

Appendix E: Data collection tools

Appendix F: Participant Information sheet

Appendix G: Consent form

Appendix H: Simulated patient role profile (Levi Williams)

Appendix I: Scenario documentation, Manikin scenario

Appendix J: Scenario documentation, Human simulated patient scenario

Appendix K: Scenario documentation, Paper-case

Appendix L: SPLINTS data

Appendix M: Extracts from transcripts

Appendix N: Reflexive thematic analysis approach

Appendix A: Glossary of terms

TERM	DEFINITION	REFERENCES
AUTHENTICITY	Genuine, real, or true. Likeness to the real world is a proxy term for authenticity.	Stokes-Parish et al., 2019
COVID-19 PANDEMIC	A global outbreak of coronavirus, an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).	World Health Organisation (2023)
CUE	To provide information during the simulation that helps the participant progress through the activity to achieve stated objectives.	Lioce et al., 2020
DEBRIEF	A formal, collaborative, reflective process that follows a simulation experience and is led by a facilitator.	Lioce et al., 2020
DIFFUSION OF INNOVATION	The process whereby innovation is articulated and shared over time with members of the social system.	Rogers, 1995
ENVIRONMENTAL FIDELITY	Refers to the degree to which the simulated environment (manikin, room, tools, equipment, moulage, and sensory props) approximates reality.	Dieckmann et al., 2007
FACILITATOR	An individual that helps to bring about an outcome (such as learning, productivity, or communication) by providing indirect or unobtrusive assistance, guidance, or supervision.	Lioce et al., 2020
FICTION CONTRACT	A concept which implies that an engagement in simulation is a contract between the instructor and the learner: each has to do his or her part to make the simulation worthwhile.	Lioce et al., 2020
FIDELITY	Believability or the degree to which a simulated experience approaches reality; as fidelity increases, realism increases. The level of fidelity is determined by the environment, the tools and resources used, and many factors associated with the participants. Fidelity can involve a variety of dimensions, including: (a) physical factors such as environment, equipment, and related tools (b) psychological factors such as emotions beliefs, and self-awareness of participants (c) social factors such as participant and instructor motivation and goals (d) culture of the group (e) degree of openness and trust, as well as participants' modes of thinking.	Dieckmann et al., 2007; INACSL Standards Committee, 2016b

HIGH FIDELITY SIMULATION	In health care simulation, high-fidelity refers to simulation experiences that are extremely realistic and provide a high level of interactivity and realism for the learner. It can apply to any mode or method of simulation; for example: human, manikin, part-task trainer, or virtual reality.	Lioce et al., 2020
HIGH FIDELITY SIMULATOR	A term often used to refer to the broad range of full-body manikins that have the ability to mimic, at a very high level, human body functions. Also known as a high-tech simulator.	Lioce et al., 2020
HUMAN FACTORS	The psychological, cultural, behavioural, and other human attributes that influence decision making, the flow of information, and the interpretation of information by individuals or groups.	Lopreiato et al., 2016
	The discipline or science of studying the interaction between humans and systems and technology.	Lioce et al., 2020
IMMERSIVE SIMULATION	A real-life situation that deeply involves the participants’ senses, emotions, thinking, and behaviour; creating an immersive simulation depends on the alignment with learning objectives, the fidelity of the simulation (physical, conceptual, and emotional), and participant´s perception of realism.	Lioce et al., 2020
IN-SITU SIMULATION	Taking place in the actual patient care setting/environment in an effort to achieve a high level of fidelity and realism; this training is particularly suitable for difficult work environments, due to space constraints or noise.	Lioce et al., 2020
LEARNING OBJECTIVE	Expected goal of a curriculum, course, lesson, or activity in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.	Lioce et al., 2020
MANIKIN	A life-sized human like simulator representing a patient for healthcare simulation and education. Full or partial body simulators that can have varying levels of physiologic function and fidelity.	Lioce et al., 2020
MANIKIN-BASED 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 et al., 2020

MODALITY	A term used to refer to the type(s) of simulation being used as part of the simulation activity, for example, task-trainers, manikin based, standardised/simulated patients, computer based, virtual reality, and hybrid.	INACSL Standards Committee, 2016b; Lioce et al., 2020
MOULAGE	The technique of creating simulated wounds, injuries, diseases, the aging processes, and other physical characteristics specific to a scenario. Special effects makeup (SPFX) and casting or moulding techniques that replicate illnesses or wounds. Used for bruising, creating wounds with wax, painting latex to achieve burns, and adding smells to the simulated environment.	Stokes-Parish et al., 2017; Stokes-Parish et al., 2019
NON-TECHNICAL SKILLS	In the healthcare field, the skills of communication, (patient, provider, team) leadership, teamwork, situational awareness, decision-making, resource management, safe practice, adverse event minimization/mitigation, and professionalism; also known as behavioural skills or teamwork skills.	Lioce et al., 2020
PHYSICAL, SEMANTICAL AND PHENOMENAL REALISM	The degree to which a participant perceives reality in physical, semantical, and phenomenal aspects of reality: ▪ Actual physical components of reality such as the physical components of a manikin. ▪ Semantical realism describes a conceptual kind of realism—for example, if bleeding occurs, a low blood pressure will result. ▪ Phenomenal realism. This kind of realism describes an emotional process, e.g. is the situation believable?	Dieckmann et al., 2007
PROCEDURAL SIMULATION	The use of a simulation modality (for example, task trainer, manikin, computer) to assist in the process of learning to complete a technical skill(s), or a procedure, which is a series of steps taken to accomplish an end.	INACSL Standards Committee, 2016b
PSYCHOLOGICAL FIDELITY	The extent to which the simulated environment evokes the underlying psychological processes that are necessary in the real-world setting. The degree of perceived realism, including psychological factors such as emotions, beliefs, and self-awareness of participants in simulation scenarios.	Dieckmann et al., 2007; Kozlowski and DeShon, 2004
REALISM	Inclination or attachment to what is real; (hence) the attitude or practice of accepting a situation as it is and being prepared to deal with it accordingly.	Oxford English Dictionary, 2008

SCENARIO	In healthcare simulation, a description of a simulation that includes the goals, objectives, debriefing points, narrative description of the clinical simulation, staff requirements, simulation room set up, simulators, props, simulator operation, and instructions for simulated patients.	Alinier, 2011
SIMULATED PATIENT	An individual who is trained to portray a real patient in order to simulate a set of symptoms or problems used for health care education, evaluation, and research.	Lioce et al., 2020
SIMULATED PERSON	A person who portrays a patient (simulated patient), family member, or health care provider in order to meet the objectives of the simulation. Alternative terms used include role-player, clinical teaching associate, trained patient, patient instructor, incognito or unannounced patient, volunteer patient, hybrid patient, actor, and confederate.	Lioce et al., 2020 Nestel and Bearman, 2015
SIMULATION	A pedagogy using one or more typologies to promote, improve, or validate a participant's progression from novice to expert. An educational technique that replaces or amplifies real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner.	Benner, 1984 Gaba, 2004
SIMULATIONIST	An individual who is involved in the design, implementation, and/or delivery of simulation activities, including, educators, technologists, operations specialists, technicians	Kardong-Edgren, 2013; Park et al., 2018; Lioce et al., 2020
SIMULATION-BASED LEARNING EXPERIENCE	An array of structured activities that represent actual or potential situations in education and practice. These activities allow participants to develop or enhance their knowledge, skills, and attitudes, or to analyse and respond to realistic situations in a simulated environment.	Pilcher et al., 2012
SOCIAL LEARNING THEORY	Active method for learning based on four mental processes, that people actively progress through to learn (Attention, Retention, Motor reproduction, and Motivation)	Bandura, 1977a

Appendix B: Literature table

	Authors	Year	Title	Summary
1	Bender, G. J.	2011	In situ simulation for systems testing in newly constructed perinatal facilities	Described a macro-systems simulation methodology to simulate and test an intensive care unit before it opened (TESTPILOT-NICU).
2	Choi, K. S., He, X., Chiang, V. C. L. and Deng, Z.	2015	A virtual reality based simulator for learning nasogastric tube placement	Proposed a virtual reality based training simulation system to facilitate the training of NGT placement. Claims the new NGT placement educational tool enhanced conventional training.
3	Dieckmann, P., Gaba, D. and Rall, M.	2007	Deepening the theoretical foundations of patient simulation as social practice	Defined three modes of thinking about simulation realism: physical, semantical and phenomenal as well as primary frames to describe cognitive structures used by learners to make sense of simulation scenarios. Concepts are introduced e.g. the ‘as if’ concept to assist with designing and conducting scenarios and as a guide to match simulation realism with desired learning outcomes.
4	Hall, A.	2003	Reading realism: Audiences' evaluations of the reality of media texts	Conceptualised media realism to discover the nature and characteristics of realistic and unrealistic media (films and television programmes). Three RQs: 1. how audiences’ perceived media realism; 2. how audiences’ understandings of realism agree with or differ from the conceptualisations that have been developed by researchers; and 3. if audiences’ use more than one conceptualisation of media realism, when these different conceptualisations are more likely to be used. Revealed six distinct methods of evaluating media realism: plausibility, typicality (representativeness), factuality, emotional involvement, narrative consistency, and perceptual persuasiveness.

5	Hamstra, S. J., Brydges, R., Hatala, R., Zendejas, B. and Cook, D. A.	2014	Reconsidering fidelity in simulation-based training	Examined key concepts and assumptions surrounding the topic of fidelity in simulation. Made three recommendations: 1. abandon the term fidelity in simulation-based health professions education and replace it with terms reflecting the underlying primary concepts of physical resemblance and functional task alignment; 2. make a shift away from the current emphasis on physical resemblance to a focus on functional correspondence between the simulator and the applied context; and 3. focus on methods to enhance educational effectiveness using principles of transfer of learning, learner engagement, and suspension of disbelief.
6	Hein, K. A., Hamid, N., Jaeger, S. R. and Delahunty, C. M.	2010	Application of a written scenario to evoke a consumption context in a laboratory setting: Effects on hedonic ratings	Developed an approach that evokes a consumption context in the sensory laboratory and studied its impact on hedonic ratings. Used a written scenario to evoke participants to imagine an occasion when they desired a refreshing beverage, versus a control. Differences in mean hedonic ratings of the samples were observed between the two conditions. Results found that consumers using the 'evoked context' found it easy to indicate their product liking/disliking and felt that the liking information they provided was accurate, more so than consumers in the control setting.
7	Johnson, D., Flagg, A. and Dremsa, T. L.	2010	Effects of using human patient simulator versus a CD-ROM on learning the management of patients exposed to chemical agents	Carried out a prospective, pretest-posttest experimental, mixed design (within and between) to determine if there were statistically significant differences between educational strategies using HPS, CD-ROM, and a control group in the care of patients exposed to chemical agents. Discovered that HPS is more effective than a CD-ROM in teaching nurses about the care of patients exposed to chemical agents.

8	Keitel, A., Ringleb, M., Schwartges, I., Weik, U., Picker, O., Stockhorst, U. and Deinzer, R.	2011	Endocrine and psychological stress responses in a simulated emergency situation	Investigated endocrine and psychological stress responses in three conditions: Rest, Laboratory stress (public speaking), and Simulated emergency situation (Sim). Discovered that: 1. Simulated emergency situations are strong stressors with profound endocrine and psychological effects. 2. Sim showed no correlation between cortisol response and performance 3. Cortisol response in a standard laboratory task was positively related to medical performance in the Sim. 4. Argues against notions that medical performance and stress responsiveness are negatively correlated. 5. Stress responses observed under simulation and laboratory stress are very similar.
9	Norman, G., Dore, K. and Grierson, L.	2012	The minimal relationship between simulation fidelity and transfer of learning	Review paper to compare learning from high fidelity simulation (HFS) with learning from low-fidelity simulation (LFS) based on measures of clinical performance. Discovered that both HFS and LFS learning resulted in consistent improvements in performance compared with no-intervention control. Nearly all the studies showed no significant advantage of HFS over LFS.
10	Poeschl, S. and Doering, N.	2013	The German VR Simulation Realism Scale–psychometric construction for virtual reality applications with virtual humans	Described the development of the German VR Simulation Realism Scale for VR training applications, which included four sub-scales measuring Scene Realism, realism of Audience Behaviour, Audience Appearance, and Sound Realism.
11	Rudolph, J. W., Simon, R. and Raemer, D. B.	2007	Which reality matters? Questions on the path to high engagement in healthcare simulation	Builds on Dieckmann et al. (2007) to re-define the term semantical mode as 'conceptual mode' and phenomenal mode as 'emotional and experiential mode'.

12	Schaumberg, A.	2015	The matter of 'fidelity': keep it simple or complex?	Described the current state of knowledge in conveying different learning objectives and the associated realism. Concluded that there is insufficient evidence to properly correlate degree of realism and knowledge transfer effectiveness - there no evidence correlating the realism of a simulation scenario with the learning success of students.
13	Stokes-Parish, J. B., Duvivier, R. and Jolly, B.	2017	Does Appearance Matter? Current Issues and Formulation of a Research Agenda for Moulage in Simulation	Explored engagement, authenticity, and realism theories in the context of moulage (SFX makeup). Further clarifies three realism characteristics: Physical (actions); Semantical (theories and concepts); Phenomenal (thoughts, emotions and beliefs).
14	Tun, J. K., Alinier, G., Tang, J. and Kneebone, R. L.	2015	Redefining simulation fidelity for healthcare education	Discussed misconceptions associated with the term 'fidelity' and proposed a 3-dimensional framework for fidelity along the axes of the patient, clinical scenario, and healthcare facilities.
15	Zola, E.	1881 in Toby Cole [Ed.] (2001).	Naturalism on the Stage *in* Playwrights on playwriting: the meaning and making of modern drama from Ibsen to Ionesco	Discussed Realism and naturalism in the context of literature and performing arts.

Appendix C: Ethical approval memo

Manchester Metropolitan
University

M E M O R A N D U M

FACULTY ACADEMIC ETHICS COMMITTEE

Faculty of Health, Psychology & Social Care

Brooks Building
Birley Fields Campus
53 Bonsall Street
Manchester
M15 6GX

+44 (0)161 247 2569

HPSCresearchdegrees@mmu.ac.uk

To: Leah Greene

From: Prof Carol Haigh

Date: 05/10/2017

Subject: Ethics Application 1299

Title: Realism in simulation-based healthcare education

Thank you for your application for an amendment to your original ethical approval.

The Faculty Academic Ethics Committee review process has recommended approval of your ethics application. This approval is granted for 42 months for full-time students or staff and 60 months for part-time students. Extensions to the approval period can be requested.

If your research changes you might need to seek ethical approval for the amendments. Please request an amendment form.

We wish you every success with your project.

Prof Carol Haigh
Chair
Faculty Academic Ethics Committee

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Appendix D: Appraisal of structured observation tools

	Name of tool	Authors	Web link	Notes	Pros and cons
1	Team Emergency Assessment Measure (TEAM)	Cooper, Cant, Porter, Sellick, Somers, Kinsman and Nestel (2010)	Adapted and modified for ALS training: https://lms.resus.org.uk/modules/m65-non-technical-skills/resources/TEAM_Emergency_Assessment_Measure.pdf	A valid instrument for the measurement of emergency non-technical skills. Teamwork observational scale to assess the performance of emergency medical teams e.g. resus and trauma teams. 12 item (11 specific and 1 global rating) were rated on a five-point scale (0 - Never/Hardly ever, 1 – Seldom, 2 About as often as not, 3 – Often, 4 – Always/Nearly always) and covered three domains: 1. Leadership 2. Teamwork 3. Task management Covers skills such as communication, adaptability, and situational awareness.	Provides an overview of the whole team performance, does not measure individual performance.
2	CARDIOTEAM checklist	Andersen, Jensen, Lippert, Ostergaard and Klausen (2010)	http://www.sciencedirect.com/science/article/pii/S0300957210000882	A formative assessment tool for measurement of performance in multi-professional resuscitation teams Yes/No checklist that is less complicated and easier to use than OSCAR.	Not yet validated and only useful in cardiac arrest scenarios.
3	Emergency Response Performance Tool (ERPT)	Arnold, Johnson, Tucker, Malec, Henrickson and Dunn (2009)	http://www.sciencedirect.com/science/article/pii/S1876139908000595	This study measured performance in a simulated ventricular tachycardia event. Comprises an Emergency Response Confidence Tool, which assesses individuals' confidence in responding to an emergency situation (17 items – self-reported, 0%-100% with 100% being the most confident for each item). A knowledge tool (11 item written exam) and a validated Emergency Response Performance Tool (ERPT) which measure time on task and a response scale for measuring participants' ability to perform tasks/procedures (0 – No, 1 – Yes, 0 – Did not assess, 1 – look, listen, feel).	Very specific and only useful in cardiac arrest scenarios.
4	The Mayo High Performance Teamwork Scale (MHPTS)	Malec, Torsher, Dunn, Wiegmann, Arnold, Brown	http://lmher.com/resources/Mayo%20Sim%20Eval%20copy.pdf	A team rating scale for assessing high performance teamwork skills in simulation medicine settings. 16-items measured on a 3-point scale (never/rarely - 0; inconsistently – 1, consistently – 2).	Rates the whole team, not individual performance. Completed by

		and Phatak (2007)		Brief, reliable, practical measure of crew resource management (CRM) skills that can be used by participants in CRM training to reflect on and evaluate their performance as a team. Further evaluation of validity and appropriateness in other simulation and medical settings is needed.	participants through reflective retrospective analysis in CRM training.
5	Non-technical skills for surgeons (NOTSS)	Yule, Flin, Paterson-Brown, Maran, and Rowley. (2006)	https://research.abdn.ac.uk/applied-psych-hf/tools/	A behaviour rating system for surgeons. The system was developed using task analysis with subject matter experts and evaluated in trials using standardized video scenarios and real operations. It allows consultant (attending) surgeons to give feedback to colleagues and trainees based on structured observations of non-technical aspects of performance during intraoperative surgery. Ratings and feedback are given on four categories of non-technical skills: 1. Situational Awareness 2. Decision Making 3. Communication & Teamwork 4. Leadership Training in NOTSS is offered by The Royal College of Surgeons of Edinburgh.	Training required to use the system. Specifically aimed at rating surgeons' behaviours.
6	Anaesthetists' Non-Technical Skills (ANTS)	Flin, Patey, Glavin and Maran. (2010)	https://research.abdn.ac.uk/applied-psych-hf/tools/	A behavioural marker system, ANTS describes the main observable non-technical skills associated with good anaesthetic practice: 1. Task Management (Planning & preparing, Prioritising, Providing & maintaining standards, Identifying & utilising resources) 2. Team Working (Co-ordinating activities with team, Exchanging information, Using authority & assertiveness, Assessing capabilities) 3. Situation Awareness (Supporting others, Gathering information, Recognising & understanding, Anticipating)	Specifically aimed at rating anaesthetists' behaviours.

				4. Decision Making (Identifying options, Balancing risks & selecting options, Re-evaluating) The purpose of the system is to provide the anaesthetic community with a framework for describing non-technical skills and a tool to guide their assessment in an explicit and transparent manner. The recommended method is to observe performance, making notes of specific behaviours or omissions. Assessment should only be based on behaviours observed directly. Using these observations, the rating can then be carried out. A four-point scale is used to describe the level of performance demonstrated (4 Good; 3 Acceptable; 2 Marginal; 1 Poor; N Not Observed).	
7	Non-technical skills system for assessing pilots' CRM skills (NOTECHS)	Flin, Martin, Goeters, Hörmann, Amalberti, Valot and Nijhuis. University of Aberdeen Industrial Psychology Research Centre and the Scottish Clinical Simulation Centre (2003)	https://research.abdn.ac.uk/applied-psych-hf/tools/	Measures Non-Technical Skills for Airline Pilots Comprises four Categories, each being subdivided into elements and behavioural markers: 1. Co-operation (Team building and maintaining, Considering others, Supporting others, Conflict solving) 2. Leadership and Managerial Skills (Use of authority and assertiveness, Providing and maintaining standards, Planning and co-ordination, Workload management) 3. Situation Awareness (Awareness of aircraft systems, Awareness of external environment, Awareness of time) 4. Decision Making (Problem definition and diagnosis, Option generation, Risk assessment and option selection, Outcome review). A separate 'communication' category is not shown in NOTECHS because communication skills are inherent in all four categories and the listed behaviours all involve communication.	Specifically aimed at rating airline pilots' behaviours. Very specific elements applicable to aviation. Communication is *not* included as separate category.
8	Scrub Practitioners' List of Intra-operative Non-Technical Skills (SPLINTS)	Mitchell, Flin, Yule, Mitchell, Coutts and Youngson. University of Aberdeen Industrial Psychology Research Centre and the Scottish	https://research.abdn.ac.uk/wp-content/uploads/sites/14/2019/03/SPLINTS-V1-0-Handbook-1.pdf	The SPLINTS system is intended for use by senior perioperative practitioners when teaching/training junior team members in the scrub role. It may also be used for peer rating of experienced scrub practitioners and for self-assessment. It is a training aid designed to assist rating scrub-practitioners' non-technical performance and give structured feedback as soon as practicable after performance. Comprised of 3 categories: 1. Situation Awareness (Gathering information, Recognising, and understanding information, Anticipating) 2. Communication and Teamwork (Acting assertively, Exchanging information, Co-ordinating with others)	Specifically aimed at rating scrub practitioners' behaviours. Communication *is* included as separate category with teamwork

		Clinical Simulation Centre (2013)		3. Task Management (Planning and preparing, Providing, and maintaining standards, Coping with pressure) Scored using a four-point rating scale: 1 (poor), 2 (marginal), 3 (acceptable) or 4 (good). Rating N/R means that those behaviours were not required for the clinical encounter being rated and that is why they were not observed.	
9	Scoring instrument for PALS simulation scenarios	Donoghue, Nishisaki, Sutton, Hales and Boulet (2010)	http://www.sciencedirect.com/science/article/pii/S0300957209005929	A reliable and valid tool comprised of a list of tasks derived from the paediatric advanced life support (PALS) treatment algorithms. Tasks are scored with a minimum of zero and maximum of 2 points with a goal of measuring whether tasks were performed at all, whether they were performed well, in a correct sequence and in a timely manner. Tasks include: Pulse check, CPR, ECG, IV/IO access, epinephrine, pulse re-check, defibrillation. Measured on a scale of 0, 1 or 2.	Valid tool but only relevant to resuscitation scenarios
10	Observed Skill-based Clinical Assessment Tool for Resuscitation (OSCAR)	Walker, Brett, McKay, Lambden, Vincent and Sevdalis (2011)	https://www.researchgate.net/profile/Nick_Sevdalis/publication/51040354_Observational_Skill-based_Clinical_Assessment_tool_for_Resuscitation_%28OSCAR%29_Development_and_validation/links/	Designed to evaluate six behavioural domains (communication, cooperation, coordination, monitoring/situation awareness, leadership and decision-making) for each of the three core team-members with leadership and coordination roles in a typical resuscitation team (Anaesthetist, Physician and Nurse). Measured on a 7-point scale from 0-6, where 0 = Team severely compromised and 6 = Highly effective in enhancing teamwork. Feasible and psychometrically sound tool to assess team behaviours during cardiac arrest resuscitation attempts. Used to assess, guide and train non-technical skills to team members. OSCAR assesses each resuscitation team-member separately capturing six behaviours in detail within these subgroups–resulting in a total of forty-eight points assessed, therefore allows feedback to individual team members on their non-technical skills.	Team measurement. Has face and content validity, Reliability, internal consistency and inter-rater reliability. TEAM may be quicker to use, OSCAR is likely to provide a more detailed and insightful breakdown

			00b7d52dd23df0c984000000.pdf		of resuscitation team behaviours.
11	Simulation module for assessment of residents targeted event responses (SMARTER)	Rosen, Salas, Silvestri, Wu and Lazzara (2008)	https://www.researchgate.net/profile/Michael_Rosen/publication/23669563_A_measurement_tool_for_simulation-based_training_in_emergency_medicine_the_simulation_module_for_assessment_of_resident_targeted_event_responses_%28SMARTER%29_approach/links/53e2e4810cf275a5fdda6dcf.pdf	A generalizable methodology for systematically linking scenario development, performance measurement, and feedback to explicitly defined learning objectives. A measurement tool that captures performance during simulation. After targeted responses for each event have been identified, event-based measurement tools can be developed readily. In the most basic case, these measurement tools take the form of event-based checklists. The events are simply ordered in time and the associated responses are grouped for each event. A check box is provided for the rater to mark whether or not the resident performed the behaviour. Hits are scored as follows: 1 = observed/performed correctly; 0 = omitted/failed to perform correctly; X = no opportunity to perform/not required; IG = instructor/confederate guided.	Designed for medics, however the method can be applied to other specialisms.

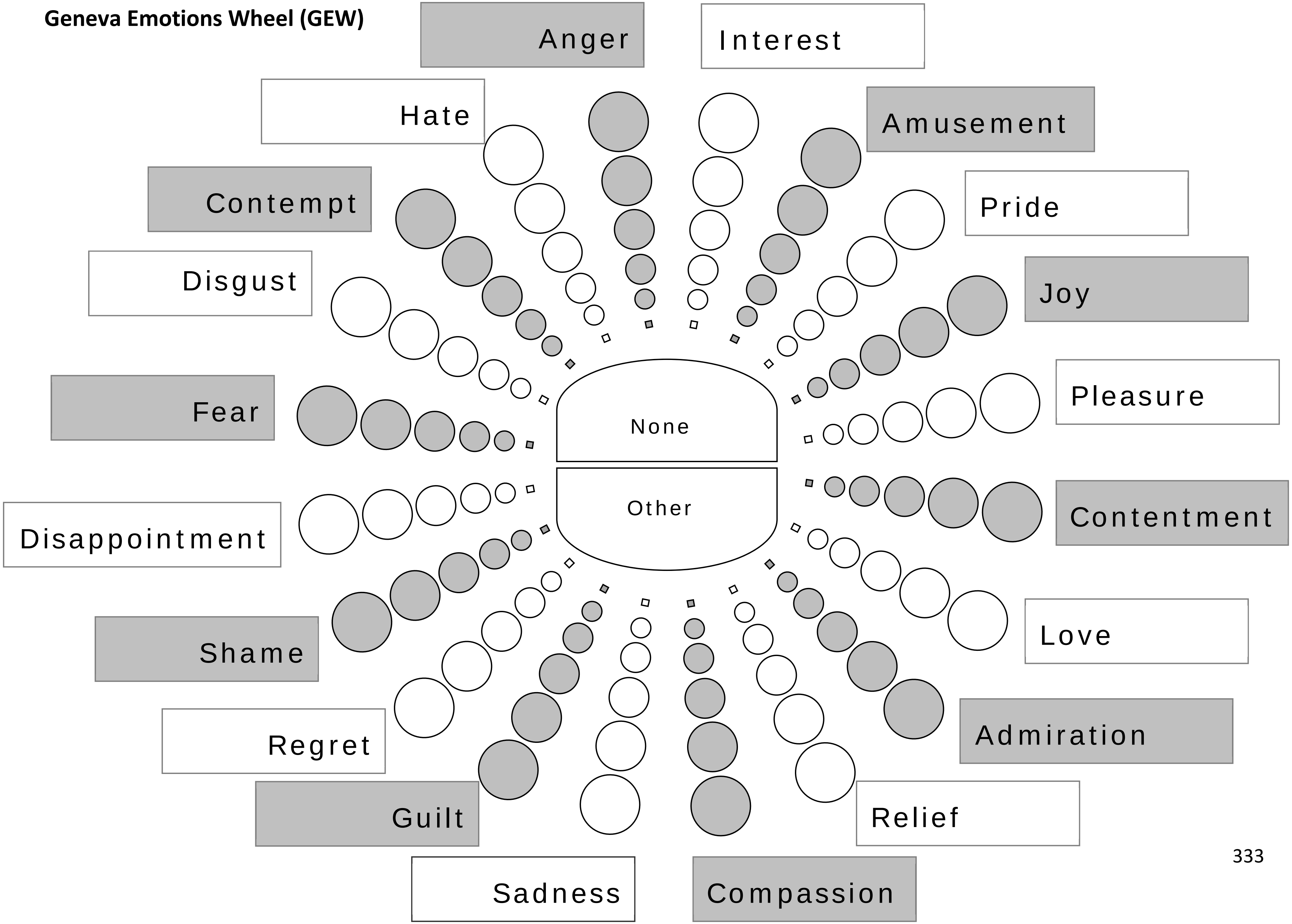
Appendix E: Data collection tools

General Self Efficacy Scale (GSES)

Please read the following statements and indicate your responses in the boxes provided.
Ensure you indicate a response for all of the questions

		Not at all true	**Hardly true**	**Moderately true**	**Exactly true**
1	I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2	If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3	It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4	I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5	Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6	I can solve most problems if I invest the necessary effort.	1	2	3	4
7	I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4
8	When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9	If I am in trouble, I can usually think of a solution.	1	2	3	4
10	I can usually handle whatever comes my way.	1	2	3	4

Geneva Emotions Wheel (GEW)



Knowledge Visual Analog Scale (VAS)

Please read the following statements and indicate your responses with a mark on the scale provided:

I can develop, justify and apply management strategies for specific patients in real-time in simulated situations

Disagree ◆————————————◆ Agree

I can critically discuss the (physiotherapy and medical) management of a deteriorating acutely unwell patient

Disagree ◆————————————◆ Agree

I am able to critically discuss the importance of human factors in the management of an acute or critically ill patient

Disagree ◆————————————◆ Agree

I have the knowledge to confidently participate in a simulated scenario and critical discussion (debrief) regarding the management of an acutely ill patient

Disagree ◆————————————◆ Agree

Realism scale

1	Ambient sound intensity in the simulation environment was…	1 = too low to 5 = too loud				
		1	2	3	4	5
2	Proportions of the simulation environment were realistic	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
3	The simulation environment seemed to be three-dimensional	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
4	Light and shades in simulation environment were realistic	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
5	Reflection in simulation environment seemed to be natural	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
6	Posture of simulated patients was natural	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
7	Facial expressions of simulated patients were realistic	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
8	Gestures of simulated patients was natural	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
9	Outfit of simulated patients was natural	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
10	Outfit of simulated patients was adequate	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
11	Simulated patients in their entirety seemed to be authentic for this occasion	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5
12	Behaviour of simulated patients in the simulation environment was authentic	1 = strongly disagree to 5 = strongly agree				
		1	2	3	4	5

Demographic information

1. Gender

	Please tick
Female	
Male	
Prefer not to say	

2. Age

	Please tick
Below 20	
21-30	
31-40	
41-50	
51-60	
Over 60	

3. Highest academic qualification

	Please tick
Diploma (PG Dip)	
Bachelor degree (e.g. BSc, BA)	
Masters degree (e.g. MSc, MA, MRes)	
PhD	
Other (please specify)…………………………………………………………	

4. Occupation

	Please tick
Public sector	
Private sector	
Voluntary sector	
Full time student	
Part time student	
Other (please specify)…………………………………………………………	

Appendix F: Participant Information sheet

FACULTY OF HEALTH, PSYCHOLOGY AND SOCIAL CARE
Department of Health Professions
Birley Campus
53 Bonsall Street
MANCHESTER
M15 6GX

Participant Information Sheet (Version 2.2, 05 Oct 17)

Study title

Realism in simulation-based healthcare education

Invitation

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

What is the overall purpose of the study?

The purpose of this study is to investigate and evaluate multiple innovative resources, methods and techniques that aim to enhance the realism of clinical simulation.

Aim of the study

The aims of this study are to discover whether enhancing realism in clinical simulation effects:

- learner's knowledge and intellectual capability
- learner's behaviours
- learner's self-efficacy
- learner's feelings and emotions

Study Objectives

To develop a common evaluation tool that can be used to investigate and evaluate multiple innovative resources, methods and techniques that aim to enhance the realism of clinical simulation.

Why have I been chosen?

You have been invited to take part in this study as you have been/are soon going to be involved in simulation at Manchester Metropolitan University (Manchester Met).

Do I have to take part?

It is up to you to decide whether or not to take part. If you decide to take part, you are still free to withdraw yourself and any information that you have provided at any time and without giving a reason. A decision to withdraw at any time or a decision not to take part, will not affect you in any way. If you chose not to take part in the research study, you will still be able to participate in the simulation sessions.

What will happen to me if I take part?

You will be required to complete a survey before and after you have taken part in two timetabled simulation sessions as part of your programme of study at Manchester Met, Brooks Building, Birley. You will also be invited to take part in an extra, optional, simulation session, which will scheduled at a time convenient to you. The survey will take no longer than 10 minutes to complete and the simulations will last 20 minutes each. The simulations will be recorded (sound and video). An expert will also observe your video recordings after the simulation, who will analyse your behaviours and non-technical skills using a rating tool called Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS).

What are the possible disadvantages of taking part?

The researcher does not anticipate that any participants will be disadvantaged by partaking in this study. It will not affect the outcome of any assessment.

What are the possible benefits of taking part?

There are no direct benefits of participating in this research study. Findings from this study will be used to inform the development of evidence to inform simulation-based healthcare education for the benefit of students. Outcomes from the study include:

- Best practice guidance for the development of simulation-based healthcare education scenarios
- PhD thesis, including impact and results of the study
- Academic journal publications and conference presentations

Will my taking part in this study be kept confidential?

Your data will be kept confidential and anonymous. You may, if you wish, provide a unique identification number on the consent form, so that if you wish to withdraw the data that you have provided at any time, the researcher can identify your comments and responses and exclude them. You are free to withdraw your data at any time until the data is analysed, without any threat to you or the study.
Paper records will be held in a locked cabinet at Manchester Met. Simulations will be recorded, and the video files will be shared securely with you via MMUTube. Video files with be held on a password-protected Manchester Met computer. All data generated from this study will be kept in accordance with the Data Protection Act (1998) for 5 years from the end of the study, and then destroyed. No identifiable information will be shared with third parties.

What will happen to the results of the research study?

Data provided by this study will be analysed and included within the Principle Investigators PhD thesis, and in future peer-reviewed publications and/or conference presentations.

The results from the evaluations will inform the development of future simulation-based healthcare education scenarios, and best practice guidance.

Who is organising and funding the research?

This research study is organised by the Principle Investigator, Leah Greene, and funded by Manchester Metropolitan University.

Who has reviewed the study?

Ethical approval has been sought and gained from Manchester Metropolitan University ethics committee (Ref. No.: 1299).

For further information about this research study, please contact:

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Project supervisor

Prof Carol Haigh
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What if there is a problem?

If you become aware of any problems arising during participation in this research study, please contact:
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Associate Dean/Research Institute Director
Faculty of Health, Psychology and Social Care
Manchester Metropolitan University
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Appendix G: Consent form

Participant Consent Form

Manchester Metropolitan University

05 Oct 2017
Leah Greene
Departments of Health Professions & Nursing
4.32, Brooks Building
Manchester Metropolitan University
Tel: 0161 247 2515

Consent Form

Title of Project: Realism in simulation-based healthcare education

Name of Researcher: Leah Greene

Participant Identification Code for this project: ________ (optional)

Please initial each box

1. I confirm that I have read and understood the information sheet dated ……………… for the above project and have had the opportunity to ask questions about the study procedures. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason to the named researcher. ☐

3. I understand that that my simulations will be recorded (sound and video) ☐

4. I give/do not give permission for my sound/video and survey data to be archived as part of this research project, making it available to future researchers. **(delete as appropriate)** ☐

5. I understand that my responses will remain anonymous. ☐

6. I agree to take part in the above research project. ☐

Name of Participant	Date	Signature
Researcher	Date	Signature

To be signed and dated in presence of the participant

Appendix H: Simulated patient role profile (Levi Williams)

Simulated Patient Role: *LEVI WILLIAMS*

Title: Levi Williams – In-patient rehabilitation scenario

Person elements of the SP role (personal information)

- Who is the person (separate from their illness/complaint)?

Levi Williams is a 61-year-old man. He is lives with his wife, Alana, and Sadie their border collie in Oldham. He is a father of 2 children: Ben aged 23, an architect and Hollie, 30, a primary school teacher. Both of their children left the family home after they returned from studying at university.

- How would you describe their personality?

Levi is lively, active and has a very caring nature. He is passionate about dogs and animals in general. Levi and his wife enjoy walking Sadie the dog together, although now Levi needs use his elbow crutches, a stick or wheelchair more often; this is affecting his mood as he longs to be more active.

Learning activity

- What is the learning activity?

The students will be asked to visit you to complete an assessment on the ward. The team may consist of 2 people, from one of the following professional groups: physiotherapy, speech and language or nursing. The Learning Outcome is to apply unit content to develop and justify the management and rehabilitation of a patient with critical illness.

- Who is the learner?

Pre-registration physiotherapy, speech and language or nursing students.

- What is expected of them?

The purpose of the scenario is to undertake an initial assessment to ensure you are suitable (stable enough) for rehabilitation. They should also complete a risk assessment, initiate rehabilitation and reposition you in a chair or wheelchair using the hoist or slide board. The Physios should feedback to the Nurse in charge about what has taken place during the session and any plans/recommendations.

- What is the setting?

In a simulated hospital General Medical Ward (side room). There will be a hospital bed, chair, bedside table, totem with oxygen, suction, nurse call system and a nurses' station with a desk, computer and chair.

- How long will they be with the patient (SP)?

The scenario will would typically last between 20-30 minutes.

- Are there any risks for the SP?

There are no physical risks to undertaking the home visit. There will be a Facilitator in the room with the students at all times, who will step in to offer assistance if the students require it. The Facilitator will also ensure the students act safely when moving and handling you.

- Are there any risks for the learner?

None identified.

- What is the most likely outcome for the patient (SP)?

The students will:

- assess you, carry out some observations, listen to your chest and reposition you
- arrange to re-visit you to develop and implement further treatments

- What is the process for learner debriefing and if there is an opportunity for SP feedback?

A debrief will be undertaken in a separate room. You will be invited to participate and provide feedback to the learner on your thoughts, feelings and behaviours. A separate prompt sheet is attached so that you can write any comments, which you wish to feedback to the individual students (see page 4).

- Will there be an audiovisual recording?

There will be no audio-visual recording of the scenario or debrief.

Context

- Why is this person in this clinical scenario?

You have been in hospital for 25 days and have become even weaker than you were at home. You spent 8 days in the intensive care unit and have been transferred to the General Medical Ward for rehabilitation before you are discharged home.

- What facts are important in this clinical scenario?

You were diagnosed with sepsis, (severe infection which has spread throughout your body and made you very unwell). This was caused by pneumonia. When you were in intensive care you required a mechanical ventilator to breathe for you for 3 days. For more information on mechanical ventilation, please see:
https://www.thoracic.org/patients/patient-resources/resources/mechanical-ventilation.pdf

Patient's history of the problem

Patient's past medical history

Multiple sclerosis (neurological condition causing weakness in your arms, legs and trunk). This affects your ability to move between your chair, wheelchair, commode, bed and car.
This has become more of a problem recently. Alana is finding it increasingly difficult to help you move around and you tend to use elbow crutches or a stick to walk but if your arms are too weak, you use a wheelchair.

Patient's family medical history

Nothing of significance.

Patient's social information

You are a retired postman. You live with your wife in a house. You are now using a bedroom and bathroom downstairs, whilst Alana is sleeping alone upstairs. You have toilet aids but Alana feels that you may now benefit from a hoist for when you are not able to transfer with minimal assistance. You are not convinced you need a hoist, as you feel that you will make improvements with physiotherapy rehabilitation. This is creating some disagreement between yourself and Alana.

What is the patient's understanding of their healthcare issue?

You understand that Multiple Sclerosis is a long-term deteriorating condition. In your case, the deterioration has been slow and you feel that this is just a little glitch and you will be back to 'your normal' soon. (Your normal status is independently moving around the house with walking aids (elbow crutches or sticks), short outdoor walks and use of your wheelchair for an 'off day'.

What are the patient's main concerns?

- You are keen to get up and about, but a little nervous as you have been in bed and very unwell for such a long period of time
- You are willing to help with the transfer – although remark that "I am not really able to help much", "I wish I could do more to help you".
- You have limited ability to move your arms and legs to assist with moving on the bed/chair//rolling over (you need 2 people to assist with this)

What is the patient's most likely outcome in this context?

- Initially as the Physios enter the room – remain quite quiet. Let them talk to you and ask questions.
- Transfers – let the Physios take the lead. Follow instructions as best as you can. Ask for clarification if you do not understand what they are trying to ask you to do.
- Repositioning in bed – as with the transfers, seek clarification throughout. Remain helpful in your manner but you need to offer little movement during repositioning on the bed. You can say "my arms are weak" and "my legs are weaker".
- Exercises – participate fully. Ask questions to ensure you know what you are required to do in each exercise. Ask "how many times a day do I need to do this?"

What is this patient's current emotion?

You have slept well and are looking forward to your physiotherapy session. You are optimistic and expecting to be taught some exercises and move around the bed/transfer to a chair or wheelchair. Be polite but push the students to get you up and moving, stressing that you want to get home as soon as possible.

Considerations for playing this role

Clothes: relaxed clothes suitable for hospital wear e.g. jogging pants, sweatshirt, tracksuit (but not PJs), with trainers/slippers/shoes (your choice). You will be expected to wear a grey wig.

Moulage (special effects makeup) – Not required.

Props –please bring with you a book, magazine, newspaper, kindle or puzzle book to keep you occupied while waiting for the students to enter the room.

For more information on multiple sclerosis, please check this website:
https://www.nhs.uk/conditions/multiple-sclerosis/

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Appendix I: Scenario documentation, Manikin scenario

Simulation Proforma

North West Simulation Education Network

Scenario title

Cardio-respiratory Physiotherapy Community Scenario

Designed for (specific group)

Pre-registration Physiotherapy students

Scenario Design team

Name	Organisation
Suzanne Gough	Manchester Metropolitan University

Date of creation

04.10.16

Reviewed

By	Date
Leah Greene	Manchester Metropolitan University

CHAPTER 9 Contents

Mental Health and Physical Health Note

It is important that we actively consider the mental health aspects of our patients, as well as the physical health ones, and include these aspects in the scenario development process. As a result, there is now a 'mental health state' in the timeline to demonstrate changes and key points; we would encourage you to consider these and work with mental health colleagues to include this element.

Why is it important?

- Mental illnesses are very common
- Among people under 65, nearly half of all ill health is mental illness
- Mental illness is generally more debilitating than most chronic physical conditions.
- Mental health problems impose a total economic and social cost of over £105bn a year
- Yet, only a quarter of all those with mental illness such as depression are in treatment
- We tend to view physical and mental health treatment in separate silos in health services
- People with poor physical health are at higher risk of experiencing mental health problems…
- …and people with poor mental health are more likely to have poor physical health

(Ref – https://www.england.nhs.uk/mentalhealth/parity/)

Values Statement and mapping

Patients, public and staff have helped develop this expression of values that is contained within the NHS Constitution and will inspire passion in the NHS and should underpin everything we do. The NHS values provide common ground for co-operation to achieve shared aspirations, at all levels of the NHS.

Value	Main focus (tick)	General Theme (tick)
Working together for patients	✓	
Compassion		✓
Respect and dignity		✓
Improving lives	✓	
Commitment to quality of care	✓	
Everyone counts		✓

Overall Goals

Develop, justify and apply management strategies for specific patients in real-time in simulated situations

Learning Objectives:

No.	Learning Objectives
1	Carry out a subjective and objective community respiratory physiotherapy assessment
2	Identify normal and abnormal values for vital signs in adults, using track and trigger patient scoring systems to identify a deteriorating patient (e.g. Patient At Risk Score (PARS), Modified Early Warning Score (MEWS) or National Early Warning Score (NEWS)
3	Contribute to the management of the acutely deteriorating adult patient
4	Work as a team to communicate with the patient and his family member
5	Carry out a range of possible physiotherapy interventions to manage a deteriorating adult patient when the cause is of a respiratory origin
6	Consider the impact of co-existing diseases such as multiple sclerosis (MS) on the physiotherapy management of a respiratory patient

Faculty Requirement:

Role	Required (tick if yes)	Notes
Facilitator	☑	Embedded in role as the patient's daughter, Hollie
Manikin Operator	☑	To voice the patient and control manikin parameters (see role profile in Appendix A)
Simulated Patient	☒	N/A
Observer	☒	N/A
Other	☑	GP/Senior Colleague/999 operator (Facilitator) available via telephone

Participants

Role	Notes
1	Actively participating in small groups of 2 or 3

Details for Facilitators

Brief Summary

See session plan in Appendix ii

Levi Williams has been referred to the community physiotherapy service by his GP. The GP referral letter explains that Mr Williams has Multiple Sclerosis (MS), and a recurrent urinary tract infection (UTI) and recent possible aspiration. He has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension. Recommendation for moving and handling included hoisting from bed to chair or wheelchair, assisted drinking and to cough post-swallow.

When you arrive at the patient's home you find Mr Williams lay in bed propped on two pillows. Levi's daughter, Hollie, takes the opportunity to nip to the chemist to collect her dad's prescribed medications. Before she leaves, she reports that Levi is currently very tired, has a weak cough and has been sleepy since yesterday. She mentions that Levi became quite chesty 2 days ago, when he had a drink of tea and thickened soup. Levi's wife, Alana, called the GP yesterday, but he has not improved overnight.

Simulation Equipment Requirement specific manikin is given for reference purposes only

Simulator	Hi-tech manikin (e.g. SimMan Essential)
Gas Supply	N/A
AV Equipment	AV recording required
Miscellaneous	Patient monitor

Set up overview

The patient needs to be set up as if he's in his own home o Dressed in casual clothes and positioned supine in bed with 2 pillows. o Catheterise patient and fill catheter with yellow coloured solution e.g. mix sterile water with yellow food colouring. Attach via catheter mount to side of the bed frame o Bed, 2 arm chairs, TV, 'fish tank', plant, radio, kettle, wardrobe to cover totem, table, cups, rugs, 'window', curtains, curtain pole, 1 x SimMan, 1 x kitbag o Radio playing in the home as a form of distraction Provide learners with a kitbag containing: o Blood pressure monitor o Saturations probe o Gloves o Aprons o Stethoscope o Thermometer o Slide sheet

Patient Demographics

Details	Mr Levi Williams
Age	61 years old
Weight	80kg
Sex	Male
Other relevant	Diagnosis of Multiple Sclerosis (MS) and a recurrent urinary tract infection (UTI)

Medical Equipment Requirement

(Equipment required to optimise fidelity of simulation) (☒ available, ☒ on manikin / actor)

Airway, C-Spine & Respiratory

Hard Collar	☐	Blocks/towels	☐	Tape	☐
Oxygen Supply	☐	O_2 Facemask	☐	O_2 Reservoir Facemask	☐
Intubated	☐	Nasal Cannula	☐	Head-box	☐
Suction	☐	Yankuer	☐	Suction Catheter	☐
Self-inflating Bag	☐	Ayers T piece	☐	Nasopharyngeal airway	☐
Oropharyngeal Airway	☐	LMA	☐	Trachy Kit	☐

Intubation Equipment: ☐	Humidified Oxygen ☐	Fiberoptic Laryngoscope ☐
Laryngoscopes (2)	ETT Sizes …………….	Bougies
T piece / circuit	Filter	Stethoscope ☒
ET CO_2 detection	Tape	
ETT position	Length at	
Ventilator ☐		
Time sec	Insp O_2 %	Rate bpm
PIP	PEEP	Other
Oxygen Sats Monitor ☒		
Nebuliser ☐		
Chest Drain ☐		

Cardiovascular

ECG leads ☐	BP cuff ☒	Picc Line ☐
Art line ☐	CVP ☐	Cannulas 20-16G ☐
Cannulas 24G ☐	Cannulas 22G ☐	Hickman Line ☐
Intraosseous kit ☐	Urinary catheter ☒	☐
Drugs (list all) ☐	Other ☐	

Neurological

Blood glucose stick ☐	Pen Torch ☐	Bleeding nares / ears ☐
Ant fontanelle bulge ☐	Other ☐	

Abdominal

AXR ☐	USS ☐	
Wound ☐	Other ☐	

Exposure / Miscellaneous

Rash ☐	Limb injury ☐	Thermometer ☒

O Negative Blood ☐	Other ☐	

Paperwork

FBC result ☐	U&Es result ☐	Blood Gas results ☐
Copy of CXR ☐	Copy of AXR ☐	Copy of CT Scan ☐
Copy of USS ☐	BNF ☐	TEG ☐
Crashcall.net sheet ☐	Em Dept sheet ☐	Drug Chart ☐
Other ☐		

Other

Duvet & duvet cover
4x pillows
Gloves, aprons
Yellow fluid for urine (in catheter bag)
Slide sheet

Available blood results:

N/A

Scenario Handover Script

S Levi Williams has been referred to the community physiotherapy service by his GP as he is currently very tired, has a weak cough and has been sleepy since yesterday. His wife, Alana, called the GP yesterday but he has not improved overnight.

B Levi has Multiple Sclerosis (MS), and a recurrent urinary tract infection (UTI) and recent possible aspiration. He has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension.

A Recommendation for moving and handling included hoisting from bed to chair or wheelchair, assisted drinking and to cough post-swallow.

R You are to visit Levi at his home, assess him and make decisions on his care.

Timeline Overview

Stage 1: Initial Physiotherapy Assessment

Learners enter the scenario, introduce themselves, meet the patient and carry out an initial assessment

Physical	
A	Airway=patent Cyanosis=none
B	RR=29 SaO_2=92% Breath sounds=crackles Right upper and basal set at Loud, Left upper normal and basal crackles
C	HR=93 BP=115/82 Cardiac Rhythm= Sinus tachycardia CRT=3 secs Temp=38.3°C
D	Pupils=PEARL Blood Glucose=6.2 AVPU=V (voice)
E	Abdominal=tone low in upper & lower limbs and around trunk

Mental Health	
Appearance/ Behaviour	In bed, unwell with weak cough
Speech	Quiet
Mood Affect	Low & agitated
Thoughts	Wants to stay at home
Perceptions	Aware
Cognition	Orientated to surroundings
Insight	Compliant with treatment

Expected Actions

- Introduce themselves to patient
- Identifies the patient appropriately by clarifying name and date of birth.
- Undertakes subjective respiratory assessment – ascertains airway patency (via patient's verbal response)
- Undertakes objective respiratory assessment including:
    - Monitors respiratory status including rate, rhythm and depth of respirations, assessing and interpreting lung sounds,
    - Monitors cardiovascular status including heart rate, blood pressure, capillary refill time, and urine output
    - Monitors disability status –AVPU/GCS
    - Undertakes head-to-toe examination
- Interprets findings and documents
- Identifies normal and abnormal values (with/without assistance)

Prompting Required

- Provide brief patient information when requested (from event column)
- Moving and handling=requires slide sheet due to patient being unable to assist in any repositioning, assist learners if requested to do so
- Infection control=MRSA precautions as unknown. Gloves for direct contact with body fluids, and /or non-intact skin, or infected tissue. Aprons for activities

	involving patient contact necessary, Mask-not necessary • Laboratory results= none available from the GP. • Chest x-ray= no reported chest x-ray on the referral letter from the GP. • Interpretation of normal/abnormal vital signs MEWS: 3 if taken on commencement of observation • No observation trend as community and no charts available) • If the participant calls for help, prompt the learner to reason the abnormal vital signs and generate a total MEWS score if not offered. Prompt the learner to reason the score and take appropriate action (referral to hospital) The MEWS score of 3 indicates the patient is acutely unwell. • Assistance: Levi is unable to reposition self or assist in movement; • Allergies: None known • Infection: Previous Urinary tract infection (now clear), MRSA screen (not known)

Stage 2: Physiotherapy interventions undertaken

Learners reposition and treat the patient

Change parameters depending on learners' interventions (see prompts below)

Physical	
A	Airway=patent Cyanosis=none
B	RR=29 SaO_2=86% Breath sounds=crackles Right upper and basal set at Loud, Left upper normal and basal crackles
C	HR=93 BP=115/82 Cardiac Rhythm= Sinus tachycardia CRT=3 secs Temp=38.3°C
D	Pupils=PEARL Blood Glucose=6.2 AVPU=V (voice)
E	Abdominal=tone low in upper & lower limbs and around trunk

Mental Health	
Appearance Behaviour	In bed, unwell with weak cough
Speech	Quiet
Mood Affect	Low & agitated
Thoughts	Wants to stay at home
Perceptions	Aware
Cognition	Orientated to surroundings
Insight	Compliant with treatment

Expected Actions

Learners initiate physiotherapy intervention including:

- Oxygen therapy – not available (patient is not prescribed home oxygen as no clinical need)
- Positioning of the patient – Left side lying for chest clearance (adhering to health & safety guidelines, infection control)
- Chest wall vibrations –Percussion/shaking/ vibrations – Right upper, mid and lower lobes, L base
- Considers physiotherapy adjuncts – IPPB, Cough assist, suction via nasal airway
- Re-assesses respiratory status following physiotherapy intervention
- Completes a structured handover to a senior physiotherapy colleague, GP/ calls 999 (communication tool used to structure handover e.g. SBAR format)

Prompting Required

Programme the patient parameters as follows if the positions are changed by the physiotherapist:

- **Supine**: SaO_2 86%, HR 93, BP 115/82, RR 28
- **Right side lying**: SaO_2 80% HR 96, BP115/84, RR29
- **Upright sitting**: SaO_2 88%, HR 93, BP 115/82, RR 28

	• **Left side lying**: SaO_2 90 increasing to 93% (no oxygen is available so will not increase saturations above 94%), HR 90, BP 115/82, RR 27 • **Optimal treatment**: (must include manual chest physiotherapy, ACBT including cough and expectoration (poor), repositioning to left side lying - SaO_2 93%, HR 87, BP 115/82, RR 23 • **Allows patient to stabilise during treatment/after treatment**: Sa02 91%, HR 89, BP 115/82, RR 24

Stage 3: Re-assessment and Handover

Learners re-assess patient's respiratory status following physiotherapy intervention

Physical	
A	Maintain physical parameters from Stage 2 depending on intervention selected
B	
C	
D	
E	

Mental Health	
Appearance Behaviour	In bed, unwell with weak cough
Speech	Quiet
Mood Affect	Low & agitated
Thoughts	Wants to stay at home
Perceptions	Aware
Cognition	Orientated to surroundings
Insight	Compliant with treatment

Expected Actions

- Re-assesses respiratory status following physiotherapy intervention including: respiratory (rate, depth and symmetry of breathing, auscultation, oxygen saturations) and cardiovascular parameters (heart rate, non-invasive blood pressure, cyanosis)
- Ascertains current cardiovascular status – acute deterioration likely
- Identification of the cause of the recent deterioration = able to suggest the cause of the recent deterioration
  - Basic interpretation=aspiration pneumonia
  - Optimal = potentially developing sepsis secondary to recent aspiration pneumonia
- Completes a structured handover to the Nurse/Doctor (e.g. SBAR format) including plan of action, when a physio is likely to return

Prompting Required

Maintain the last position/intervention option from Stage 2 whilst the handover is undertaken (to senior physiotherapy colleagues, GP or telephone call to 999).
Prompt the learners to escalate the patient to a higher level of care (the patient asks throughout the scenario "Are you going to send me to the hospital again?")
Encourage the learners to use a standardised communication tool during the handover (e.g. SBAR format): Situation, Background, Assessment, Recommendations
Physiotherapy Plan: Prompt for information relating to next physiotherapy intervention and physiotherapy plan if not offered in the handover.

	GP/Senior Colleague/999operator (Facilitator's) instructions: Request a handover from the learners using the SBAR format: Situation, Background, Assessment (prompting for MEWS score) and Recommendations. Learner should escalate the patient to a higher level of care and recognises the patient is acutely unwell, requiring a comprehensive assessment in hospital to appropriately diagnose the patient's problems and needs intervention than cannot be offered at home (e.g. oxygen therapy).

Key Debrief Points (always delivered and linked to the learning objectives)

No	Points
1	Talk me through how you carried out a subjective and objective community respiratory physiotherapy assessment
2	Which techniques did you use to identify normal and abnormal values for vital signs in adults, e.g. did you use track and trigger patient scoring systems to identify that the patient was deteriorating (e.g. Patient At Risk Score (PARS), Modified Early Warning Score (MEWS) or National Early Warning Score (NEWS)
3	Tell me how you contributed to the management of this acutely deteriorating adult patient
4	How did you work as a team to communicate with the patient, his family member and any other healthcare professionals? What communication strategies did you use? Talk to me about your use of SBAR in this scenario
5	Describe the physiotherapy interventions you used to manage this deteriorating adult patient – did you select an appropriate course of action? If not, what would you do differently?

Key message slides / handouts

Following participation in the session the students should be able to:

1. Critically discuss collaborative management designed to prevent further deterioration of an acutely ill adult patient
2. Critically discuss the use of track and trigger scoring systems (e.g. PARS, MEWS or NEWS) to identify the deterioration of adult patients
3. Deliver an appropriate handover using a standardised (e.g. SBAR) approach
4. Critically discuss the use of communication aids (e.g. SBAR) within the handover of acutely ill patients

Session conclusion:

- Recap learning outcomes and link this session to Simulation B scenario.
- Direct the students to self-reflective resources on Moodle to document their reflection on their participation in the scenario and encourage them to upload this to their ePortfolio.

Simulated Patient Information (optional) (SP role profile can be included as an appendix to this scenario template)

Please refer to Levi Williams' SP role profile in Appendix i

Supportive Educational Material

Standards for recognition / treatment

- **Modified Early warning Score (MEWS)**: Subbe CP. Kruger M. Rutherford P. Gemmel L. (2001) Validation of a modified Early Warning Score in medical admissions. QJM, 9410, pp. 521-526
- **Patient At Risk Scoring (PARS) System Clinical Guideline**: Worcestershire Primary Care NHS Trust (2010) Patient At Risk Scoring System Clinical Guideline. Worcestershire: Worcestershire Primary Care Trust. June 2010. [Online] www.worcestershire.nhs.uk/file_download.aspx?id=4c747f85-9bb8-4096-8be7-d6641d32569c
- **The SBAR Tool**: NHS England and NHS Improvement Online library of Quality, Service Improvement and Redesign tools. SBAR communication tool – situation, background, assessment, recommendation [Online] https://www.england.nhs.uk/wp-content/uploads/2021/03/qsir-sbar-communication-tool.pdf

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SBAR Tool
http://www.institute.nhs.uk/safer_care/safer_care/Situation_Background_Assessment_Recommendation.html

Patient Safety First – Patient Safety Resources

http://www.patientsafetyfirst.nhs.uk/Content.aspx?path=/interventions/patient-safety/

Patient Safety First – Human Factors Resources

http://www.patientsafetyfirst.nhs.uk/Content.aspx?path=/interventions/humanfactors/

Patient Safety Concepts – brief introduction

http://www.institute.nhs.uk/safer_care/primary_care_2/patient_safety_concepts.html

Appendix i – Levi Williams role profile

Title: Levi Williams – Home Visit

Person elements of the SP role (personal information)

- Who is the person (separate from their illness/complaint)?
  Levi Williams is a 61-year-old man. He lives with his wife, Alana and Sadie their border collie in Oldham. He is a father of 2 children: Ben aged 23, an architect and Hollie, 30, a primary school teacher. Both of their children left the family home after they returned from studying at university.

- How would you describe their personality?
  Levi is lively, active and has a very caring nature. He is passionate about dogs and animals in general. Levi and his wife enjoy walking Sadie the dog together, although now Levi needs to use his elbow crutches, a stick or wheelchair more often; this is affecting his mood as he longs to be more active.

Learning activity

- What is the learning activity?

The students will be asked to undertake a home visit. The team may consist of 2 people, from one of the following professional groups: physiotherapy, speech and language or nursing. The Learning Outcome is to develop, justify and apply management strategies for specific patients in real-time in a simulated situation.

- Who is the learner?

Pre-registration physiotherapy, speech and language or nursing students.

- What is expected of them?

The purpose of the home visit is to undertake a respiratory assessment and provide advice on positioning in bed, a chair/wheelchair. They will decide on a plan of action based on what they discover during the assessment.

- What is the setting?

A home environment, prepared to look like a living room with a single bed.

- How long will they be with the patient (SP)?

The home visit would typically last between 20-30 minutes.

- Are there any risks for the SP?

There are no physical risks to undertaking the home visit. Due to the requirements of the scenario (increased respiration rate, added lung sounds etc) the role will be played by a manikin – you will voice the manikin from a soundproof booth next door to the sim lab. You will be able to see the students and respond verbally to their actions.

- Are there any risks for the learner?

None identified.

- What is the most likely outcome for the patient (SP)?

The students will either:

- carry out some interventions, reposition you and arrange to re-visit you at a time that is convenient to develop and implement a treatment plan

or

- refer you to hospital if they feel they cannot treat you at home.

- What is the process for learner debriefing and if there is an opportunity for SP feedback?

A debrief will be undertaken in a separate room. You will be invited to participate and provide feedback to the learner on your thoughts, feelings and behaviours. A separate prompt sheet is attached so that you can write any comments, which you wish to feedback to the individual students.

- Will there be an audio-visual recording?

There will be no audio-visual recording of the scenario or debrief, unless otherwise specified.

Context

- Why is this person in this clinical scenario?

You have been referred to the community physiotherapy service by your GP. The GP referral letter explains that you have has Multiple Sclerosis, and a recurrent urinary tract infection (UTI) and recent possible aspiration.

- What facts are important in this clinical scenario?

When the students arrive, you are very tired, have a weak cough and have been sleepy since yesterday. You became quite chesty 2 days ago, when you had a drink of tea and thickened soup. Alana called the GP yesterday and you have not improved overnight.

Patient's history of the problem

- Patient's past medical history

Multiple sclerosis (MS), which is a neurological condition causing weakness in your arms, legs and trunk. This affects your ability to move between your chair, wheelchair, commode, bed and car.

This has become more of a problem recently. Alana is finding it increasingly difficult to help you move around and you tend to use elbow crutches or a stick to walk but if your arms are too weak, you use a wheelchair.

You take the following medications: Interferon Beta 1a, for relapsing MS, and Tizanidine to reduce muscle spasms.

- Patient's family medical history

Nothing of significance.

- Patient's social information

You are a retired postman. You live with your wife in a house. You are now using a bedroom and bathroom downstairs, whilst Alana is sleeping alone upstairs. You have toilet aids but Alana feels that you may now benefit from a hoist for when you are not able to transfer with minimal assistance. You are not convinced you need a hoist, as you feel that you will make improvements with physiotherapy rehabilitation. This is creating some disagreement between yourself and Alana.

- What is the patient's understanding of their healthcare issue?

You understand that Multiple Sclerosis is a long-term deteriorating condition. In your case, the deterioration has been slow and you feel that this is just a little glitch and you will be back to 'your normal' soon. (Your normal status is independently moving around the house with walking aids (elbow crutches or sticks), short outdoor walks and use of your wheelchair for an 'off day'.

- What are the patient's main concerns?

That you are feeling unwell, have a 'chesty' cough and do not seem to be improving.
You want to be able to get up out of bed and feel better.

- What is the patient's most likely outcome in this context?

The students should:

  - Undertake a respiratory assessment
  - Monitor your respiratory status including rate, rhythm and depth of respirations, assessing and interpreting lung sounds
  - Monitor your cardiovascular status including heart rate, blood pressure, capillary refill time, and urine output
  - Monitor your level of consciousness - you will be responding to their voices
  - Undertake a head-to-toe examination
  - Attempt to provide some advice on positioning, and some interventions to clear the fluid from your lungs.
  - The students will probably decide to refer you to hospital if they feel they cannot treat you successfully at home.

- What is this patient's current emotion?

At the moment, you are feeling sleepy and rather poorly due to aspirating on a cup of tea (when the food/drink goes 'down the wrong way' into your lungs).

Considerations for playing this role

Clothes – the manikin will be dressed in relaxed clothing and wearing a grey wig.

Moulage (special effects makeup) – Not required.

Props – Chairs, table, rugs, lamp, radio, cupboard, commode, sticks/elbow crutches, wheelchair, 'home items'.

For more information on multiple sclerosis, please check this website: https://www.nhs.uk/conditions/multiple-sclerosis/

Scenario Authors: Suzanne Gough (s.gough@mmu.ac.uk) and Leah Greene (l.greene@mmu.ac.uk), Manchester Metropolitan University, Feb 2015, updated Oct 2017.

Appendix ii - Session Plan

Time	Duration	Activity	Room	Group 1	Group 2	Group 3	Group 4	Group 5
13:00-13:10	10 mins	Introduction to sim: https://www.youtube.com/watch?v=sJvM00AOu60&feature=youtu.be Who is Levi? https://mmutube.mmu.ac.uk/media/Introducing+Levi+Williams_subtitles.mp4/1_oxdb7stj Whole group – pre questionnaires	BR 4.08	All - Introduction				
13:10		SIMULATION STARTS						
13:10-13:30	20 mins	Group 1 Simulation	BR 4.05	Sim		Break & self-directed study in BR 4.08	Break & self-directed study in BR 4.08	Break & self-directed study in BR 4.08
		Group 1 – post questionnaires	BR 4.25					
13:30-13:32	2 mins	Change-over						
13:32-13:52	20 mins	Group 2 Simulation	BR 4.05	Break & self-directed study in BR 4.08	Sim			
		Group 2 – post questionnaires	BR 4.25					
13:52-13:54	2 mins	Change-over						
13:54-14:14	20 mins	Group 3 Simulation	BR 4.05		Break & self-directed study in BR 4.08	Sim		
		Group 3 – post questionnaires	BR 4.25					
14:14-14:16	2 mins	Change-over						
14:16-14:36	20 mins	Group 4 Simulation	BR 4.05			Break & self-directed study in BR 4.08	Sim	
		Group 4 – post questionnaires	BR 4.25					
14:36-14:38	2 mins	Change-over						
14:38-14:58	20 mins	Group 5 Simulation	BR 4.05					Sim
		Group 5 – post questionnaires	BR 4.25					
15:00		SIMULATION ENDS						
15:05		DEBRIEF STARTS						
15:05-16:00	55 mins	Whole group debrief	BR 4.08	All - debrief				

Appendix J: Scenario documentation, Human simulated patient scenario

Simulation Proforma

North West Simulation Education Network

Scenario title

Cardio-respiratory Physiotherapy In-patient Scenario

Designed for (specific group)

Pre-registration Physiotherapy students

Scenario Design team

Name	Organisation
Suzanne Gough	Manchester Metropolitan University

Date of creation

04.10.16

Reviewed

By	Date
Leah Greene	Manchester Metropolitan University

CHAPTER 10 Contents

Mental Health and Physical Health Note

It is important that we actively consider the mental health aspects of our patients, as well as the physical health ones, and include these aspects in the scenario development process. As a result, there is now a 'mental health state' in the timeline to demonstrate changes and key points; we would encourage you to consider these and work with mental health colleagues to include this element.

Why is it important?

- Mental illnesses are very common
- Among people under 65, nearly half of all ill health is mental illness
- Mental illness is generally more debilitating than most chronic physical conditions.
- Mental health problems impose a total economic and social cost of over £105bn a year
- Yet, only a quarter of all those with mental illness such as depression are in treatment
- We tend to view physical and mental health treatment in separate silos in health services
- People with poor physical health are at higher risk of experiencing mental health problems…
- …and people with poor mental health are more likely to have poor physical health

(Ref – https://www.england.nhs.uk/mentalhealth/parity/)

Values Statement and mapping

Patients, public and staff have helped develop this expression of values that is contained within the NHS Constitution and will inspire passion in the NHS and should underpin everything we do. The NHS values provide common ground for co-operation to achieve shared aspirations, at all levels of the NHS.

Value	Main focus (tick)	General Theme (tick)
Working together for patients	✓	
Compassion		✓
Respect and dignity		✓
Improving lives	✓	
Commitment to quality of care	✓	
Everyone counts		✓

Overall Goals

Apply unit content to develop and justify the management and rehabilitation of patients with critical illness

Learning Objectives:

No.	Learning Objectives
1	Carry out a subjective and objective respiratory physiotherapy assessment
2	Identify normal and abnormal values for vital signs in adults, using track and trigger patient scoring systems to identify a deteriorating patient (e.g. Patient At Risk Score (PARS), Modified Early Warning Score (MEWS) or National Early Warning Score (NEWS)
3	Contribute to the management and rehabilitation of an adult patient recovering from acute deterioration and mechanical ventilation
4	Work as a team to communicate with the patient
5	Carry out a range of possible physiotherapy interventions to manage and rehabilitate an adult patient recovering from deterioration when the cause is of a respiratory origin
6	Consider the impact of co-existing diseases such as multiple sclerosis (MS) on the physiotherapy management of a respiratory patient

Faculty Requirement:

Role	**Required** (tick if yes)	**Notes**
Facilitator	☑	Embedded in role as the Nurse
Manikin Operator	☑	To control the patient monitor and make any changes & answer telephone if required.
Simulated Patient	☑	In role as the patient (see role profile in Appendix A)
Observer	☒	N/A
Other	☒	N/A

Participants

Role	Notes
1	Actively participating in small groups of 2 or 3

Details for Facilitators

Brief Summary

See session plan in Appendix iv Levi Williams was admitted to the hospital 25 days ago. During this time, he was admitted to critical care for 8 days following admission from home. Levi was diagnosed with sepsis secondary to pneumonia and required mechanical ventilation for 3 days. His admission diagnosis was Multiple Sclerosis, and a recurrent urinary tract infection (UTI). The previous physiotherapy assessment findings indicate that he has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension. Recommendation for moving and handling included hoisting from bed to chair or wheelchair, assisted drinking and to cough post-swallow. The Staff Nurse in charge reports that the Mr Williams slept well; she has requested a re-assessment, stating that he is ready for physiotherapy and interventions today.

Simulation Equipment Requirement specific manikin is given for reference purposes only

Simulator	N/A
Gas Supply	Available of required via totem
AV Equipment	AV recording required
Miscellaneous	Patient monitor

Set up overview

The patient needs to be set up as if he's in hospital: o Dressed in a hospital gown and positioned sat up in bed with 2 pillows. o Fill catheter bag with yellow coloured solution e.g. mix sterile water with yellow food colouring. Attach via catheter mount to side of the bed frame or via a leg-bag. Kit available: o Blood pressure monitor o Saturations probe o Gloves o Aprons o Stethoscope o Thermometer o Slide sheet

Patient Demographics

Details	Mr Levi Williams
Age	61 years old
Weight	100kg
Sex	Male
Other relevant	Lives with his wife Alana and their dog Sadie. Diagnosis of Multiple Sclerosis (MS) and a recurrent urinary tract infection (UTI)

Medical Equipment Requirement

(Equipment required to optimise fidelity of simulation) (☒ available, ☒ on manikin / actor)

Airway, C-Spine & Respiratory

Hard Collar	☐	Blocks/towels	☐	Tape	☐
Oxygen Supply	☒	O_2 Facemask	☒	O_2 Reservoir Facemask	☐
Intubated	☐	Nasal Cannula	☐	Head-box	☐
Suction	☒	Yankuer	☐	Suction Catheter	☐
Self-inflating Bag	☐	Ayers T piece	☐	Nasopharyngeal airway	☐
Oropharyngeal Airway	☐	LMA	☐	Trachy Kit	☐
Intubation Equipment:	☐	Humidified Oxygen	☐	Fiberoptic Laryngoscope	☐
Laryngoscopes (2)		ETT Sizes ……………..		Bougies	

T piece / circuit	Filter	Stethoscope ☒
ET CO_2 detection	Tape	
ETT position	Length at	
Ventilator ☐		
Time sec	Insp O_2 %	Rate bpm
PIP	PEEP	Other
Oxygen Sats Monitor ☒		
Nebuliser ☐		
Chest Drain ☐		

Cardiovascular

ECG leads ☐	BP cuff ☒	Picc Line ☐
Art line ☐	CVP ☐	Cannulas 20-16G ☐
Cannulas 24G ☐	Cannulas 22G ☐	Hickman Line ☐
Intraosseous kit ☐	Urinary catheter ☒	☐
Drugs (list all) ☐	Other ☐	

Neurological

Blood glucose stick ☐	Pen Torch ☒	Bleeding nares / ears ☐
Ant fontanelle bulge ☐	Other ☐	

Abdominal

AXR ☐	USS ☐	
Wound ☐	Other ☐	

Exposure / Miscellaneous

Rash ☐	Limb injury ☐	Thermometer ☒
O Negative Blood ☐	Other ☐	

Paperwork

FBC result ☐	U&Es result ☐	Blood Gas results ☐
Copy of CXR ☒	Copy of AXR ☐	Copy of CT Scan ☐

Copy of USS	☐	BNF	☐	TEG	☐
Crashcall.net sheet	☐	Em Dept sheet	☐	Drug Chart	☐
Other	☐				

Other

Bed sheet, blanket
4x pillows
Gloves, aprons
Yellow fluid for urine (in catheter bag)
Slide sheet, hoist, Zimmer frame, elbow crutches

Available blood results:

N/A

Scenario Handover Script

S Levi Williams was admitted to hospital 25 days ago by paramedic transfer with sepsis secondary to pneumonia. He is recovering and is ready for physiotherapy rehabilitation and interventions.

B Levi has Multiple Sclerosis (MS), and a recurrent urinary tract infection (UTI) and recent aspiration. He has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension.

A Recommendation for moving and handling included hoisting from bed to chair or wheelchair, assisted drinking and to cough post-swallow.

R You are to visit Levi in hospital, assess him and make decisions on his care and discharge.

Timeline Overview

Stage 1: Initial Physiotherapy Assessment

Learners enter the scenario, introduce themselves, meet the patient and carry out an initial assessment

Physical	
A	Airway=patent Cyanosis=none
B	RR169 SaO_2=94% on room air Breath sounds=normal
C	HR=85 BP=115/82 Cardiac Rhythm= Sinus tachycardia CRT=2 secs Temp=37.2°C
D	Pupils=PEARL Blood Glucose=6.2 AVPU=A (alert)
E	Abdominal=tone low in upper & lower limbs and around trunk

Mental Health	
Appearance/ Behaviour	In bed, sat up
Speech	Alert, chatty
Mood Affect	Slightly agitated
Thoughts	Wants to go home
Perceptions	Aware
Cognition	Orientated to surroundings
Insight	Compliant with treatment

Expected Actions

- Introduce themselves to patient
- Identifies the patient appropriately by clarifying name and date of birth
- Undertakes subjective respiratory assessment – ascertains airway patency (via patient's verbal response)
- Undertakes objective respiratory assessment including:
  - Monitors respiratory status including rate, rhythm and depth of respirations, assessing and interpreting lung sounds,
  - Monitors cardiovascular status including heart rate, blood pressure, capillary refill time, and urine output
  - Monitors disability status –AVPU/GCS
  - Undertakes head-to-toe examination
- Interprets findings and documents
- Identifies normal and abnormal values (with/without assistance)

Prompting Required

- Provide brief patient information when requested (from event column)
- Moving and handling=requires slide sheet (patient can assist in any repositioning, assist learners if requested to do so)
- Infection control=MRSA precautions required. Gloves for direct contact with body fluids, and /or non-intact

	skin, or infected tissue. Aprons for activities involving patient contact necessary, Mask-not necessary • Laboratory results= provide if requested (see Appendix v) • Chest x-ray= provide chest x-ray if requested (see Appendix vi). Interpretation assistance if learner unable to identify problem. Prompt learner to identify normal and abnormal findings • Interpretation of normal/abnormal vital signs MEWS: 0 if taken on commencement of observation • Assistance: Levi is able to reposition self with assistance; • Allergies: None known • Infection: Previous Urinary tract infection (now clear), Positive MRSA screen on admission

Stage 2: Physiotherapy interventions undertaken

Learners reposition and begin interventions

Physical	
A	Airway=patent Cyanosis=none
B	RR169 SaO_2=94% on room air Breath sounds=normal
C	HR=85 BP=115/82 Cardiac Rhythm= Sinus tachycardia CRT=2 secs Temp=37.2°C
D	Pupils=PEARL Blood Glucose=6.2 AVPU=A (alert)
E	Abdominal=tone low in upper & lower limbs and around trunk

Mental Health	
Appearance Behaviour	In bed, sat up
Speech	Alert, chatty
Mood Affect	Slightly agitated
Thoughts	Wants to go home
Perceptions	Aware
Cognition	Orientated to surroundings
Insight	Compliant with treatment

Expected Actions

Initiates intervention including:

- Assess the patient's ability to transfer on the bed
- Complete a risk assessment
- Initiate rehabilitation: repositioning the patient in a chair or wheelchair using the hoist or slide board.
- Provides an appropriate handover to the nursing staff regarding the patient's mobility status (e.g. using SBAR format)

Prompting Required

- Nurse to prompt that lunch/dinner is arriving soon and it would be good to get Levi out of bed
- Levi to prompt that he feels well and wants to get up and about so he can go home

Stage 3: Re-assessment and Handover

Learners re-assess patient's respiratory status following physiotherapy intervention

Physical	
A	Maintain physical parameters from Stage 2 depending on intervention selected
B	
C	
D	
E	

Mental Health	
Appearance Behaviour	In bed, sat up
Speech	Alert, chatty
Mood Affect	Slightly agitated
Thoughts	Wants to go home
Perceptions	Aware
Cognition	Orientated to surroundings
Insight	Compliant with treatment

Expected Actions

- Re-assesses respiratory status following physiotherapy intervention including: respiratory (rate, depth and symmetry of breathing, auscultation, oxygen saturations) and cardiovascular parameters (heart rate, non-invasive blood pressure, cyanosis)
- Ascertains current cardiovascular status – stable and appropriate for rehabilitation
- Completes a structured handover to the Nurse/Doctor (e.g. SBAR format) including mobility status, plan of action, when a physio is likely to return

Prompting Required

Handover = prompt for structured approach Situation, Background, Assessment, Recommendations (SBAR)

Physiotherapy Plan = Prompt for information relating to next physiotherapy intervention and physiotherapy plan if not offered in the (SBAR) handover

Nurse to provide vital sign information/blood test results and chest x-ray interpretation assistance (to recognise trends, interpretations or re-cap values) at the request of the learner

Nurse to request a handover from the physiotherapist when the intervention has been provided.

Key Debrief Points (always delivered and linked to the learning objectives)

No	Points
1	Talk me through how you carried out a subjective and objective respiratory physiotherapy assessment
2	Which techniques did you use to identify normal and abnormal values for vital signs in adults, e.g. did you use track and trigger patient scoring systems to identify that the patient was deteriorating (e.g. Patient At Risk Score (PARS), Modified Early Warning Score (MEWS) or National Early Warning Score (NEWS)
3	Tell me how you contributed to the management and rehabilitation of this adult patient
4	How did you work as a team to communicate with the patient and any other healthcare professionals? What communication strategies did you use? Talk to me about your use of SBAR in this scenario
5	Describe the physiotherapy interventions you used to manage and rehabilitate this adult patient – did you select an appropriate course of action? If not, what would you do differently?
6	Tell me about the impact of the patient's co-existing condition (MS) on your physiotherapy management, were there any challenges?

Key message slides / handouts

Following participation in the session the students should be able to:

1. Critically discuss collaborative management and rehabilitation designed to prevent further deterioration of an acutely ill adult patient in hospital
2. Critically discuss the use of track and trigger scoring systems (e.g. PARS, MEWS or NEWS) to identify the deterioration of adult patients
3. Deliver an appropriate handover using a standardised (e.g. SBAR) approach
4. Critically discuss the use of communication aids (e.g. SBAR) within the handover of acutely ill patients

Session conclusion:

- Recap learning outcomes and link this session to further Unit content.
- Direct the students to self-reflective resources on Moodle to document their reflection on their participation in the scenario and encourage them to upload this to their ePortfolio.

Simulated Patient Information (optional) (SP role profile can be included as an appendix to this scenario template)

Please refer to Levi Williams' SP role profile in Appendix iii

Supportive Educational Material

Standards for recognition / treatment

- **Modified Early warning Score (MEWS)**: Subbe CP. Kruger M. Rutherford P. Gemmel L. (2001) Validation of a modified Early Warning Score in medical admissions. QJM, 9410, pp. 521-526
- **Patient At Risk Scoring (PARS) System Clinical Guideline**: Worcestershire Primary Care NHS Trust (2010) Patient At Risk Scoring System Clinical Guideline. Worcestershire: Worcestershire Primary Care Trust. June 2010. [Online] www.worcestershire.nhs.uk/file_download.aspx?id=4c747f85-9bb8-4096-8be7-d6641d32569c
- **The SBAR Tool**: NHS England and NHS Improvement Online library of Quality, Service Improvement and Redesign tools. SBAR communication tool – situation, background, assessment, recommendation [Online] https://www.england.nhs.uk/wp-content/uploads/2021/03/qsir-sbar-communication-tool.pdf

Clinical presentation / progression

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NWSEN eWorkshop – Human Factors – SCORM package uploaded onto Moodle

SBAR Tool
http://www.institute.nhs.uk/safer_care/safer_care/Situation_Background_Assessment_Recommendation.html

Patient Safety First – Patient Safety Resources

http://www.patientsafetyfirst.nhs.uk/Content.aspx?path=/interventions/patient-safety/

Patient Safety First – Human Factors Resources

http://www.patientsafetyfirst.nhs.uk/Content.aspx?path=/interventions/humanfactors/

Patient Safety Concepts – brief introduction

http://www.institute.nhs.uk/safer_care/primary_care_2/patient_safety_concepts.html

Appendix iii – Levi Williams role profile

Title: Levi Williams – In-patient rehabilitation scenario

Person elements of the SP role (personal information)

- Who is the person (separate from their illness/complaint)?
  Levi Williams is a 61-year-old man. He lives with his wife, Alana and Sadie their border collie in Oldham. He is a father of 2 children: Ben aged 23, an architect and Hollie, 30, a primary school teacher. Both of their children left the family home after they returned from studying at university.

- How would you describe their personality?
  Levi is lively, active and has a very caring nature. He is passionate about dogs and animals in general. Levi and his wife enjoy walking Sadie the dog together, although now Levi needs to use his elbow crutches, a stick or wheelchair more often; this is affecting his mood as he longs to be more active.

Learning activity

- What is the learning activity?

The students will be asked to visit you to complete an assessment on the ward. The team may consist of 2 people, from one of the following professional groups: physiotherapy, speech and language or nursing. The Learning Outcome is to apply unit content to develop and justify the management and rehabilitation of a patient with critical illness.

- Who is the learner?

Pre-registration physiotherapy, speech and language or nursing students.

- What is expected of them?

The purpose of the scenario is to undertake an initial assessment to ensure you are suitable (stable enough) for rehabilitation. They should also complete a risk assessment, initiate rehabilitation and reposition you in a chair or wheelchair using the hoist or slide board. The Physios should feedback to the Nurse in charge about what has taken place during the session and any plans/recommendations.

- What is the setting?

In a simulated hospital General Medical Ward (side room). There will be a hospital bed, chair, bedside table, totem with oxygen, suction, nurse call system and a nurses' station with a desk, computer and chair.

- How long will they be with the patient (SP)?

The home visit would typically last between 20-30 minutes.

- Are there any risks for the SP?

There are no physical risks to undertaking the home visit. There will be a Facilitator in the room with the students at all times, who will step in to offer assistance if the students require it. The Facilitator will also ensure the students act safely when moving and handling you.

- Are there any risks for the learner?

None identified.

- What is the most likely outcome for the patient (SP)?

The students will:
  - assess you, carry out some observations, listen to your chest and reposition you
  - arrange to re-visit you to develop and implement further treatments

- What is the process for learner debriefing and if there is an opportunity for SP feedback?

A debrief will be undertaken in a separate room. You will be invited to participate and provide feedback to the learner on your thoughts, feelings and behaviours. A separate prompt sheet is attached so that you can write any comments, which you wish to feedback to the individual students.

- Will there be an audio-visual recording?

There will be no audio-visual recording of the scenario or debrief, unless otherwise specified.

Context

- Why is this person in this clinical scenario?

You have been in hospital for 25 days and have become even weaker than you were at home. You spent 8 days in the intensive care unit and have been transferred to the General Medical Ward for rehabilitation before you are discharged home.

- What facts are important in this clinical scenario?

You were diagnosed with sepsis, (severe infection which has spread throughout your body and made you very unwell). This was caused by pneumonia. When you were in intensive care you required a mechanical ventilator to breathe for you for 3 days. For more information on mechanical ventilation, please see:
https://www.thoracic.org/patients/patient-resources/resources/mechanical-ventilation.pdf

Patient's history of the problem

- Patient's past medical history

Multiple sclerosis (MS), which is a neurological condition causing weakness in your arms, legs and trunk. This affects your ability to move between your chair, wheelchair, commode, bed and car.

This has become more of a problem recently. Alana is finding it increasingly difficult to help you move around and you tend to use elbow crutches or a stick to walk but if your arms are too weak, you use a wheelchair.

You take the following medications: Interferon Beta 1a, for relapsing MS, and Tizanidine to reduce muscle spasms.

- Patient's family medical history

Nothing of significance.

- Patient's social information

You are a retired postman. You live with your wife in a house. You are now using a bedroom and bathroom downstairs, whilst Alana is sleeping alone upstairs. You have toilet aids but Alana feels that you may now benefit from a hoist for when you are not able to transfer with minimal assistance. You are not convinced you need a hoist, as you feel that you will make improvements with physiotherapy rehabilitation. This is creating some disagreement between yourself and Alana.

- What is the patient's understanding of their healthcare issue?

You understand that Multiple Sclerosis is a long-term deteriorating condition. In your case, the deterioration has been slow and you feel that this is just a little glitch and you will be back to 'your normal' soon. (Your normal status is independently moving around the house with walking aids (elbow crutches or sticks), short outdoor walks and use of your wheelchair for an 'off day'.

- What are the patient's main concerns?

  - You are keen to get up and about, but a little nervous as you have been in bed and very unwell for such a long period of time
  - You are willing to help with the transfer – although remark that "I am not really able to help much", "I wish I could do more to help you".
  - You have limited ability to move your arms and legs to assist with moving on the bed/chair//rolling over (you need 2 people to assist with this)

- What is the patient's most likely outcome in this context?

  - Initially as the Physios enter the room – remain quite quiet. Let them talk to you and ask questions.
  - Transfers – let the Physios take the lead. Follow instructions as best as you can. Ask for clarification if you do not understand what they are trying to ask you to do.
  - Repositioning in bed – as with the transfers, seek clarification throughout. Remain helpful in your manner but you need to offer little movement during repositioning on the bed. You can say "my arms are weak" and "my legs are weaker".

- Exercises – participate fully. Ask questions to ensure you know what you are required to do in each exercise. Ask "how many times a day do I need to do this?"

- What is this patient's current emotion?

You have slept well and are looking forward to your physiotherapy session. You are optimistic and expecting to be taught some exercises and move around the bed/transfer to a chair or wheelchair. Be polite but push the students to get you up and moving, stressing that you want to get home as soon as possible.

Considerations for playing this role

Clothes: relaxed clothes suitable for hospital wear e.g. jogging pants, sweatshirt, tracksuit (but not PJs), with trainers/slippers/shoes (your choice). You will be expected to wear a grey wig.

Moulage (special effects makeup) – Not required.

Props –please bring with you a book, magazine, newspaper, kindle or puzzle book to keep you occupied while waiting for the students to enter the room.

For more information on multiple sclerosis, please check this website: https://www.nhs.uk/conditions/multiple-sclerosis/

Scenario Authors: Suzanne Gough (s.gough@mmu.ac.uk) and Leah Greene (l.greene@mmu.ac.uk), Manchester Metropolitan University, Feb 2015, updated Oct 2017.

Appendix iv - Session Plan

Time	Duration	Activity	Room	Group 5	Group 4	Group 3	Group 2	Group 1
11:00-11:10	10 mins	Introduction Re-cap - who is Levi? https://mmutube.mmu.ac.uk/media/Introducing+Levi+Williams_subtitles.mp4/1_oxdb7stj Whole group – pre questionnaires	BR 4.08	All - Introduction				
11:10		SIMULATION STARTS						
11:10-11:30	20 mins	Group 5 Simulation	BR 4.07	Sim		Break & self-directed study in BR 4.08	Break & self-directed study in BR 4.08	Break & self-directed study in BR 4.08
		Group 5 – post questionnaires	BR 4.25					
11:30-11:32	2 mins	Change-over						
11:32-11:52	20 mins	Group 4 Simulation	BR 4.07	Break & self-directed study in BR 4.08y	Sim			
		Group 4 – post questionnaires	BR 4.25					
11:52-11:54	2 mins	Change-over						
11:54-12:14	20 mins	Group 3 Simulation	BR 4.07		Break & self-directed study in BR 4.08	Sim		
		Group 3 – post questionnaires	BR 4.25					
12:14-12:16	2 mins	Change-over						
12:16-12:36	20 mins	Group 2 Simulation	BR 4.07			Break & self-directed study in BR 4.08	Sim	
		Group 2 – post questionnaires	BR 4.25					
12:36-12:38	2 mins	Change-over						
12:38-12:58	20 mins	Group 1 Simulation	BR 4.07					Sim
		Group 1 – post questionnaires	BR 4.25					
13:00		SIMULATION ENDS						
13:05		DEBRIEF STARTS						
13:05-14:00	55 mins	Whole group debrief	BR 4.08	All - debrief				

Appendix v – Lab test results

MANCHESTER METROPOLITAN FOUNDATION HOSPITAL TRUST

Forename	Surname	
Levi	Williams	
Consultant	Hospital number	
Dr Beck	#87654321	
Ward	DOB	Age
S2	01-01-1955	61

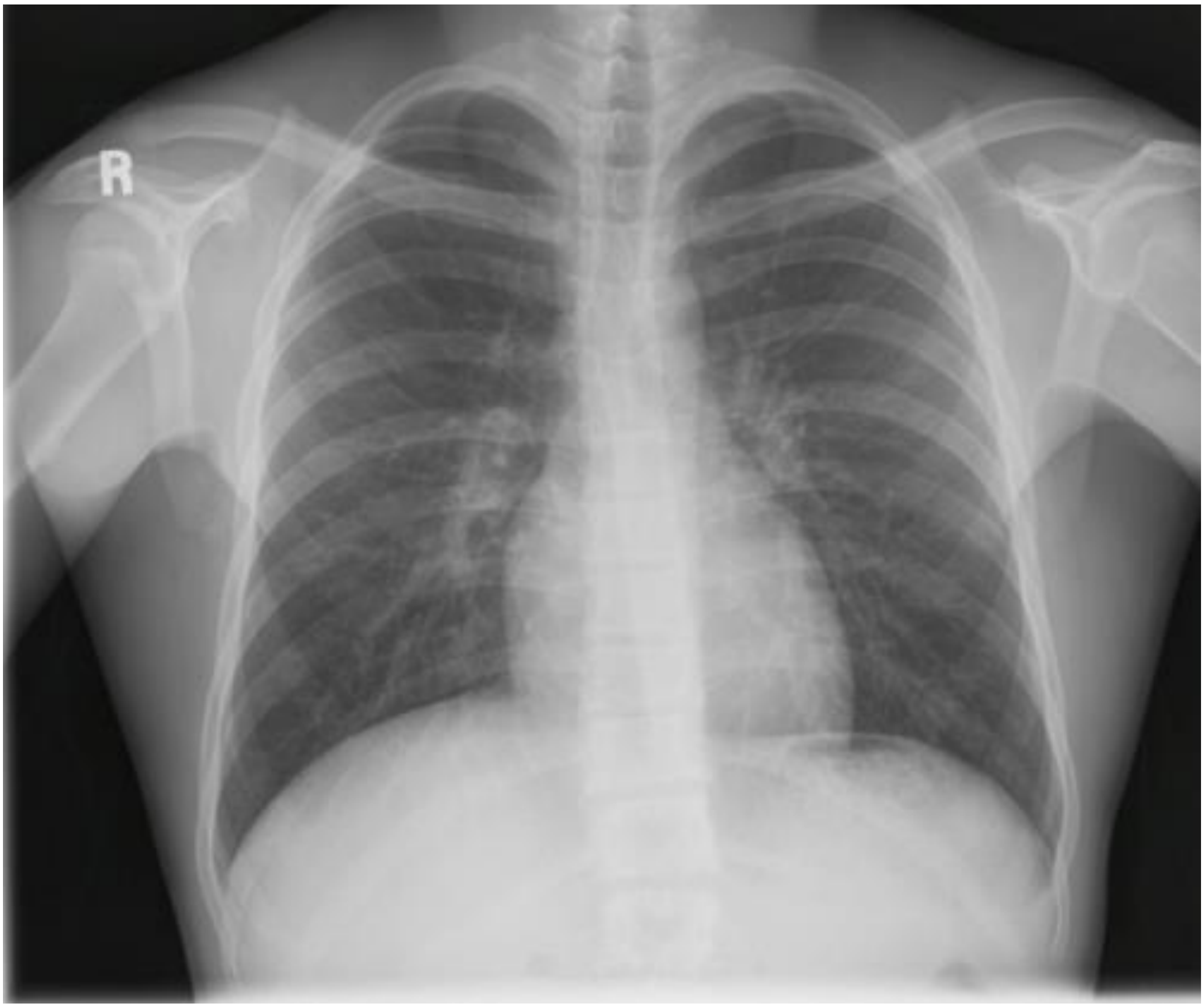
Blood test results

Test	Result	Units	Normal range (males)
Hb	140	g/L	130-180
RBC	5.20	10^{12}/L	4.50-6.50
HCT	0.43	L/L	0.40-0.54
MCV	89.0	fL	80.0-100.0
MCH	30.0	pg	27.0-32.0
MCHC	299	g/L	285-330
WBC	4.6	10^9/L	3.6-11.0
PLT	389	10^9/L	140-400
Neutrophils	6.0	10^9/L	1.8-7.5
Lymphocytes	2.6	10^9/L	1.0-4.0
Monocytes	0.6	10^9/L	0.2-0.8
Eosinophils	0.3	10^9/L	0.1-0.4
Basophils	0.06	10^9/L	0.01-0.1
ESR	8	mm/h	2-10
Plasma viscosity	1.61	mPa/s	1.50-1.72
Reticulocytes	100	10^9/L	76-130
Serum B_{12}	560	ng/L	180-1000
Serum folate	6	µg/L	>4.0
Serum ferritin	290	µg/L	25-350

ABG results

Test	Results	Normal range
pH	7.40	7.35-7.45
$PaCO_2$ (mmHg)	39.8	35-45
HCO_3 (mmol/L)	24	21-28
PaO_2 (mmHg)	105	80-110
Base Excess	+1	-2-+2

Appendix vi – Chest x-ray



Appendix K: Scenario documentation, Paper-case

MAICIP Simulation C: Community Physiotherapy Information

Physiotherapy Simulation-based learning experience – Levi Williams

Scenario: MAICIP Cardio-respiratory Physiotherapy Community Scenario C

Simulated Patient:

Location: Patient's Home

History/Information:
Levi Williams has been referred to the community physiotherapy service following discharge from critical care. The referral letter explains that Mr Williams has Multiple Sclerosis (MS), and a history of recurrent urinary tract infections (UTIs) and recent aspiration resulting in ventilation and 29 days in hospital. He has low tone in his upper, lower limbs and thorax. He has restrictive thoracic movement in particular extension. Upon discharge, the Physiotherapist recommended moving and handling with assistance of 1 from bed to chair or wheelchair. He is currently sleeping in the living room and has a commode.

When you arrive at the patient's home you find Mr Williams sat in the living room. Levi's wife, Alana, answers the door and informs you that she is worried about his mobility and low mood. Before leaving to walk Sadie the dog, she reports that Levi is more tired than usual; he still cannot use the stairs, although he is constantly asking to try on his own so he can sleep in the bedroom upstairs and have a bath.

Healthcare Providers Information:
GP diagnosis: Multiple Sclerosis
Condition: rehabilitation post-discharge from critical care
MRSA: unknown at present
Cough: none
Urinary catheter: in situ
Allergies: None known
Medication: Interferon Beta 1a, for relapsing MS, and Tizanidine to reduce muscle spasms.

Learning Objectives/Outcomes

Relevant Unit Learning Outcomes

On successful completion of this Unit, students will be able to:

1. Systematically and critically evaluate relevant literature underpinning evidence-based practice.
2. Synthesise and analyse research findings in order to make value judgements about their contribution to the clinical evidence base.
3. Develop reasoned arguments in order to evaluate clinical decisions.
4. Engage effectively in debate, arguing and evaluating a variety of viewpoints in a professional manner to produce detailed and coherent arguments.
5. Critically examine and reflect on their own practice and their own implementation of best available evidence and develop an understanding of some of the problems of implementing research findings into clinical practice.

During this session you will have the opportunity to consider how to:

1. Develop, justify and apply management strategies for specific patients in real-time in simulated situations

Instructions

There are **three parts** to this scenario, you have **20 minutes in total** to complete your assessment and decision-making. For each part of the scenario, consider the 'Events' and 'Prompts' provided. Write down in the table provided any actions that you would undertake if you were the Community Physiotherapist responding to this referral in the patients' home.

You have a bag containing the following equipment with you:

- Blood pressure monitor
- Saturations probe
- Gloves
- Aprons
- Stethoscope
- Thermometer
- Slide sheet

Part 1	Events	List of required actions	Prompts
Initial Physiotherapy Assessment (10:00 hours)	RR=14; HR=82; BP= 125/82; SaO_2=97% Temperature=36.9 Breath sounds= Normal, no added sounds; Cardiac Rhythm= Sinus; Bowel sounds= Normal; Lethargic and weak; Tone=low in upper & lower limbs and around trunk Pupils=PEARL ***A-E assessment:*** **Airway** = Patent, self-ventilating, Cyanosis=none; **Breathing** =Good expansion, all areas, no accessory muscle use, no increased work of breathing, normal breath sounds. Cough=adequate; **Circulation** = Skin pale, warm, CRT 2 secs, UO 1009, 50mls in last hour; **Disability =** alert, low mood, PEARL, Blood Glucose 4.0; **Exposure =** tone low in upper & lower limbs and around trunk. **Assistance** = able to reposition self and assist in movement; mobile around living room with Zimmer frame, although tends to leave this and use furniture to assist instead **Allergies:** None known **Infection:** Previous urinary tract (now clear), Positive MRSA screen on last hospital admission; **MEWS:** 0 at 10:00hrs.		• Patient History/Information available • Bag containing equipment is provided • Consider moving and handling • Consider AVPU • Consider infection control • Laboratory results = none available from the GP. • Chest x-ray = no reported chest x-ray on the discharge letter from the GP. • Consider MEWS score • No observation trend as community setting - no charts available • What does the MEWS score of 0 indicate?

Part 2	Events	List of required actions	Prompts
Continued assessment (10:10 hours)	Whilst talking to Levi and conducting the Initial Assessment (Part 1), you notice some bruises on his wrists and lower arms (see Appendix 1). In conversation, he mentions that Alana is struggling with the extra responsibility since he came out of hospital; she has been upset and he has heard her crying from the other room. Levi states that she doesn't mean to hurt him, and maintains it's his fault for being so helpless. **Appendix i** 		• Consider risk assessment and risk rating tools • How will you gather information? • Is the individual at risk of significant harm now and in the future? • Consider Alana's mental health and risk assessment • How do you consider safeguarding at all times, and in particular within the assessment process? • Reflect on your own training needs

Part 3	Events
Documentation and Action Plan (10:20 hours)	Complete documentation following Initial Assessment (Part 1) Document your problem list and Action Plan Is handover required? Who would the handover be given to, considering Mr Williams is at home? What information would you provide?
Documentation **Action Plan and** **List of required actions**	

Appendix L: SPLINTS data

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimA (Manikin scenario) - Group 1

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	4	Collects information from daughter & patient
		Recognising and understanding information	4	Recognises cues, prompts, urgency
		Anticipating	4	Predicts need for ambulance, understands patient cannot stay at home without intervention
Communication and Teamwork	4	Acting Assertively	4	Recognises own limitations, enforces need to call for ambulance, communicates well with daughter to ensure she's on-board with decisions. Gives clear instructions, sat patient up in bed, explained need to move patient to hospital despite his refusal and urgency.
		Exchanging information	4	Introduces themselves, gains consent, uses non-verbal signals e.g. therapeutic touch to reassure patient
		Co-ordinating with others	4	Communicates well with other team members & daughter, provides help and assistance
Task Management	3	Planning and preparing	3	Unprepared - needed a pen to write observations down - didn't have one
		Providing and maintaining standards	3	Did not control volume of radio - distracting
		Coping with pressure	4	Maintains an even tone of voice, does not panic or raise voice, delegates tasks - one stayed with patient, while one called ambulance and spoke to daughter
TOTAL	**11**	**TOTAL**	**34**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimA (Manikin scenario) - Group 2

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	3	Gathering information	4	Collects information from daughter & patient,
		Recognising and understanding information	2	Doesn't pick up on cues, prompts or urgency
		Anticipating	2	Doesn't think ahead to predict what might happen BUT suggests call to GP and SLT
Communication and Teamwork	3	Acting Assertively	2	Gives clear instructions (breathing exercises) and explains why it is necessary BUT doesn't demonstrate awareness of own limitations or recognise urgency or patients' condition
		Exchanging information	4	Introduces themselves. Provides team members, daughter and patient with clear information, uses appropriate language to explain what they are doing
		Co-ordinating with others	4	Supports, helps and provides assistance for each other
Task Management	3	Planning and preparing	2	Demonstrates difficulty in locating required equipment, unprepared, doesn't bring kit (stethoscope, pen, paper to write observations) with them BUT overcomes difficulties to carry out most of assessment and uses kit that is available
		Providing and maintaining standards	3	Did not control volume of radio - distracting
		Coping with pressure	4	Maintains an even tone of voice, delegates tasks - one stayed with patient, while one spoke to daughter
TOTAL	**9**	**TOTAL**	**27**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimA (Manikin scenario) - Group 3

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	4	Collects information from daughter & patient
		Recognising and understanding information	4	Recognises urgency of patient condition, uses structured approach (A-E)
		Anticipating	4	Predicts what may happen, and recognises own limitations and why calling GP is not the best option
Communication and Teamwork	4	Acting Assertively	4	Communicates in a clear and precise manner, explains well to patient
		Exchanging information	4	Introduces themselves, explains why they are there, gains consent
		Co-ordinating with others	3	At first all trying to do the same task at the same time BUT after a while, settles into roles well and coordinates tasks. Sometimes failed to pick up on patient's cues
Task Management	3	Planning and preparing	4	Arrives prepared, brings appropriate equipment
		Providing and maintaining standards	3	Did not control volume of radio - distracting
		Coping with pressure	3	Takes initiative, maintains even tone of voice BUT sometimes appears patronising
TOTAL	**11**	**TOTAL**	**33**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimA (Manikin scenario) - Group 4

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	2	Gathering information	3	Collects information from daughter & patient
		Recognising and understanding information	2	Doesn't pick up on cues, prompts or urgency
		Anticipating	2	Doesn't think ahead to predict what might happen
Communication and Teamwork	2	Acting Assertively	1	Gives vague instructions, doesn't recognise urgency or patients' deteriorating condition
		Exchanging information	2	Does not introduce themselves. Does not gain consent or provide daughter and patient with clear information, doesn't explain clearly what they are doing
		Co-ordinating with others	2	Provides some limited support and assistance for each other
Task Management	3	Planning and preparing	3	Arrives prepared and uses kit that is available
		Providing and maintaining standards	2	Fixated on pain, excludes patient from discussions & decision-making
		Coping with pressure	3	Maintains an even tone of voice, limited delegation of tasks.
TOTAL	**7**	**TOTAL**	**20**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimB (Human SP) - Group 1

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	4	Ask questions, collects information from nurse and patient, checks notes, checks previous observations, constant monitoring
		Recognising and understanding information	4	Interprets patient observations and recognises patient requests to go home
		Anticipating	4	Assesses risk, need for observations and assessment prior to moving patient.
Communication and Teamwork	4	Acting Assertively	4	Gives clear instructions to patient
		Exchanging information	4	Introduces themselves, gains consent, asks questions
		Co-ordinating with others	4	Allocates roles, clear communication between patient and Team, encourages/reassures patient
Task Management	3	Planning and preparing	3	Clear plan of actions, structured approach to assess patient, not rushed BUT no PPE worn (catheter leak), and shoes not placed in correct location prior to needing them
		Providing and maintaining standards	4	Considers patient safety and risk
		Coping with pressure	3	Aware of time pressure, and urgency of patient need to stand/move/go home BUT didn't get patient up out of bed
TOTAL	**11**	**TOTAL**	**34**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor Performance was not acceptable and could potentially have endangered patient safety, remedial action is required

2 Marginal Performance indicated cause for concern, considerable improvement is needed

3 Acceptable Performance was of a satisfactory standard but could be improved

4 Good Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others

N/R Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimB (Human SP) - Group 2

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	4	Asks questions, collects information from nurse and patient, checks previous observations, monitors observations when changed position (sat up)
		Recognising and understanding information	4	Recognises prompts & cues from patient, recognises patient's requests to get home
		Anticipating	4	Recognises requirement for three people to assist, gets shoes ready before moving patient
Communication and Teamwork	3	Acting Assertively	3	Uses non-assertive language e.g. shall we…
		Exchanging information	3	Did not introduce themselves BUT explains what they are doing to patient, doesn't always communicate clearly with patient, some confusion, BUT reassures him
		Co-ordinating with others	4	Works well as a team, one on each side of the bed, Team ask for help and help each other out when needed
Task Management	4	Planning and preparing	4	Clear plan of how to assess patient before moving him, shoes placed in correct location prior to needing them
		Providing and maintaining standards	4	Considers patient safety and risk
		Coping with pressure	4	Recognises time pressure to get patient in chair before lunch time
TOTAL	**11**	**TOTAL**	**34**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor — Performance was not acceptable and could potentially have endangered patient safety, remedial action is required

2 Marginal — Performance indicated cause for concern, considerable improvement is needed

3 Acceptable — Performance was of a satisfactory standard but could be improved

4 Good — Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others

N/R — Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimB (Human SP) - Group 3

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	3	Asks questions, checked previous observations, assesses patient before moving him, BUT does not take additional observations
		Recognising and understanding information	4	Recognises prompts & cues from patient
		Anticipating	4	Gets shoes ready before moving patient, moves chair to other side of bed
Communication and Teamwork	3	Acting Assertively	3	Sometimes uses non-assertive language, e.g. can we do, shall we…
		Exchanging information	3	Introduces themselves, gains consent, some confusion
		Co-ordinating with others	2	Discusses options with Team BUT excludes one of the members of the Team
Task Management	4	Planning and preparing	4	Washes hands, gloves/aprons worn, clear plan of actions, structured approach to assess patient, shoes placed in correct location prior to needing them
		Providing and maintaining standards	4	Considers risk and patient safety
		Coping with pressure	4	Recognises time pressure to get patient in chair before lunch time
TOTAL	**11**	**TOTAL**	**31**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimB (Human SP) - Group 4

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	3	Asks questions, checked previous observations, BUT did not reassess patient observations
		Recognising and understanding information	4	Recognises prompts & cues from patient
		Anticipating	4	Recognises need for space and slippers prior to moving patient & requirement for three people to assist
Communication and Teamwork	4	Acting Assertively	4	Gives clear instructions to patient
		Exchanging information	4	Introduces themselves, gains consent
		Co-ordinating with others	4	Discusses options with Team, clear leader, asks for help when needed, help each other out when needed
Task Management	4	Planning and preparing	4	Washes hands, gloves/aprons worn, clear plan of actions, structured approach to assess patient, shoes placed in correct location prior to needing them, discusses options between Team & with patient
		Providing and maintaining standards	4	Considers risk and patient safety
		Coping with pressure	4	Aware of time pressure, and urgency of patient need to stand/move/go home
TOTAL	**12**	**TOTAL**	**35**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimC (Paper-case) - Group 1

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	4	Read case study in detail
		Recognising and understanding information	4	Picked up on important prompts & cues
		Anticipating	3	Considered equipment required for assessment
Communication and Teamwork	4	Acting Assertively	3	Used assertive language, recognised own limitations
		Exchanging information	4	Discussed options and ideas
		Co-ordinating with others	4	Listened and actively engaged with each other, helped each other out
Task Management	4	Planning and preparing	4	Wrote notes & developed action plan
		Providing and maintaining standards	4	Considered PPE, safeguarding, social services involvement, risk assessment scales and patient safety
		Coping with pressure	3	Recognised time pressure, completed tasks, remained calm throughout
TOTAL	**12**	**TOTAL**	**33**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimC (Paper-case) - Group 2

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	4	Gathering information	4	Read case study in detail in silence
		Recognising and understanding information	4	Asked questions, picked up on cues & prompts – goals to access bath/bedroom to improve low mood & quality of life
		Anticipating	4	Made notes and listed problems and actions
Communication and Teamwork	4	Acting Assertively	4	Acknowledged own limitations e.g. didn't know process for safeguarding
		Exchanging information	4	Discussed options and ideas together & helped each other out
		Co-ordinating with others	4	Acknowledged patient & wife's need for support, e.g. referrals - home carers, social services
Task Management	3	Planning and preparing	3	Discussed options to assess patient and include wife in assessment process
		Providing and maintaining standards	4	Discussed gaining consent, safeguarding, considered domestic violence, risk assessment
		Coping with pressure	3	Aware of time pressures, moved on to action plan BUT ran out of time remained calm & professional
TOTAL	**11**	**TOTAL**	**34**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimC (Paper-case) - Group 3

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	3	Gathering information	4	Read case study in detail in silence
		Recognising and understanding information	2	Made notes and listed problems and actions BUT didn't seem to pick up on the cues and prompts
		Anticipating	3	Acknowledge own limitations e.g. didn't know process for reporting safeguarding. Made notes
Communication and Teamwork	2	Acting Assertively	2	Quietly spoken, underconfident, not assertive
		Exchanging information	2	Mumbling, whispering, lots of silence, seemed disengaged
		Co-ordinating with others	3	Recognised need to include wife in assessment BUT suggested they would tell her 'you're doing it wrong'. Acknowledged need to report to superiors
Task Management	3	Planning and preparing	3	Discussed action plan & need for SMART goals
		Providing and maintaining standards	3	Mentioned safeguarding,
		Coping with pressure	2	No urgency to complete scenario, went off-topic, not focussed on tasks. Appeared unprofessional & disengaged
TOTAL	**8**	**TOTAL**	**24**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor	Performance was not acceptable and could potentially have endangered patient safety, remedial action is required
2 Marginal	Performance indicated cause for concern, considerable improvement is needed
3 Acceptable	Performance was of a satisfactory standard but could be improved
4 Good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
N/R	Not Required; skill was not observed because it was not required in this case

SPLINTS v1.0 (Category rating: Min 3, Max 12, Element rating: Min 9, Max 36)

SimC (Paper-case) - Group 4

Category	Category rating*	Element	Element rating*	Feedback on performance and debriefing notes
Situational Awareness	3	Gathering information	3	Read case study in detail out loud BUT without depth of understanding
		Recognising and understanding information	2	Asked questions when in doubt, picked up on cues & prompts BUT some confusion about observations and abbreviations e.g. PEARL, CRP (cultural differences)
		Anticipating	4	Made notes and listed problems and actions, discussed psychological impact
Communication and Teamwork	4	Acting Assertively	4	Confident, clear communication
		Exchanging information	4	When unsure, helped each other out, explained things, supported each other
		Co-ordinating with others	4	Adjusted seating so whole group could see the paper case, and actively engaged with each other. Acknowledged need for social services involvement
Task Management	3	Planning and preparing	4	Discussed action plan & need for short-term goals
		Providing and maintaining standards	4	Discussed need for family to be involved in patient's care, family education, risk, safeguarding vulnerable adults
		Coping with pressure	2	Spent too much time on first part of scenario, so ran out of time. Remained calm, some unprofessional behaviours, e.g. checking mobile phone
TOTAL	**10**	**TOTAL**	**31**	

* 1 Poor; 2 Marginal; 3 Acceptable; 4 Good; N/A Not Required

1 Poor — Performance was not acceptable and could potentially have endangered patient safety, remedial action is required

2 Marginal — Performance indicated cause for concern, considerable improvement is needed

3 Acceptable — Performance was of a satisfactory standard but could be improved

4 Good — Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others

N/R — Not Required; skill was not observed because it was not required in this case

Appendix M: Extracts from transcripts

SimA (Manikin Scenario)

Group 2 – 19min 12sec

Space: What is the physical space like?	A home environment with a radio playing in the background, a manikin lay in bed
Actors: Who is involved?	Two student learners, one manikin patient (Levi), one SP relative (daughter, Hollie)
Goals: What do they want to accomplish?	Overall goal: Develop, justify and apply management strategies for specific patients in real-time in simulated situations.
Objects: What objects are present?	Tablet device, bag with equipment, radio, bed, armchair, small set of draws, wardrobe, manikin in bed, blue duvet, two pillows, stethoscope, blood pressure monitor, sats probe, clip board, slide sheet, telephone
Event: What kind of event is it?	A simulated home-visit by healthcare professionals (Physios)

[cough cough]

Learner 1: so we're going to have a chat to you dad, er first, but are you planning to stay in or?

Hollie: Erm, well, I've got to go to the pharmacist my mum's not been back. She's somewhere [cough] I've got to go at some point to the pharmacy. So I'll be going in about five minutes. I can hang around, but I've got to catch them before they close for lunchtime.

Learner 1: Yes

Hollie: Erm because we haven't got some of his medications

Learner 1: do you mind us staying or do you want us to come back another time?

Hollie: No, no, no as long as you're alright staying because he'd be on his own anyway.

Learners: Yeah.

Hollie: If I feel comfortable leaving then I'll go [laughs] is that alright?

Learners: Yeah. Yeah. Yeah

Introductions (comms skills)

Hollie: come on in, that's fine

Learner 1: hi Levi, are you okay? My name is ** and this is ** we're the physios

Levi: [groaning]

Learner 2: Hello Levi

Levi: [mumbling]

Learner 2: how are you feeling?

Levi: I'm not feeling well at all really

Cue (verbal)

Learner 1: you're not feeling too well?

Levi: No

Learner 1: Erm now Hollie's just got to nip out to the shops, erm, are you happy with us to stay here while she's nips out?

Levi: Yeah

Learner 1: Yes, is that okay? Right so we've been reading that you're having a bit of trouble with your chest, is that right?

Levi: [cough cough, cough cough] Yeah.

Learner 1: you've been having a bit of trouble with your swallowing as well?

[Learner 2 stood with hands behind back away from the bed]

Positioning in the room (lack of engagement)

Levi: yeah, yeah

Learner 1: Yeah and have you seen anyone about your swallowing?

Levi: err

Learner 1: Have you seen some salt, erm, speech and language, have they been to see you?

Levi: I can't remember

Learner 1: if you can't remember that's fine.

Levi: I'm not feeling well

Learner 1: how aren't you feeling well? What's, what's bothering you?

Levi: [weak cough] I've got, I feel tired

Learner 1: uh huh

Levi: I can't breathe properly

Learner 1: Yeah. And are you feeling like you can't breathe because it feels tight or is it because you're feeling you're tired?

Levi: [weak cough] what did you say?

Learner 1: that's ok, I was just saying are you having trouble with your breathing because you're feeling really tired or is it feeling a bit tighter? Or?

Levi: I'm not sure, dunno

Learner 1: you're not sure, okay

[Learner 1 nodding, looks over at Learner 2]

Learner 2: what have you been drinking and eating? Kind of a normal diet, Levi, or are you on any special diet?

Levi: errr, I think I had some soup

Cue (verbal)

Learner 2: okay, you had some soup

Levi: yeah

Learner: you've not had any, erm, kind of thickener given to you have you, off anybody?

Levi: I'm not sure, I don't know

Learner 2: okay. Are those your…[talking over the top of Levi] Sorry, carry on.

Levi: just soup

Learner 1: Soup, yeah.

Learner 2: [looks away from bed towards Hollie] Hollie, has your dad had any kind of powder [moves hand around in circles – stirring motion] or any anything off the Speech and Language team that thickens fluids?

Hollie: Oh, yeah. Sometimes he has thickened fluids, he has like, when he's not feeling so good, he has like thick complan-y, is complan one of the things?

Learner 2: yeah

Hollie: it's like a milk-shakey thing [cough cough]. Erm, that's not every day or anything like that.

Learners: no, okay

Cue (verbal)

Hollie: the thickener thing, though, he'll have a cuppa tea or a cuppa coffee, of things like that [cough cough] but [to Levi] you weren't so good the other the day, you had a cuppa tea [to the Learners] my mum was saying he just, you know, was like coughing and spluttering it was like it'd gone down the wrong way or something.

SimB (Human SP scenario)

Group 3 – 20min 48sec

Space: What is the physical space like?	A clinical environment with a person sat up in bed reading a book
Actors: Who is involved?	Two student learners, one patient (Levi), one SP healthcare professional (Nurse)
Goals: What do they want to accomplish?	Overall goal: Apply unit content to develop and justify the management and rehabilitation of patients with critical illness
Objects: What objects are present?	Tablet device, equipment, bed, armchair, bedside locker, patient in bed, white sheet, blue banket, two pillows, stethoscope, blood pressure monitor, sats probe, clip board, slide sheet, desk and chair, telephone, oxygen, suction, water jug, glass
Event: What kind of event is it?	A simulated in-patient hospital visit by healthcare professionals (Physios)

Learner 1: hiya Levi

Levi: hello

All: hi

Nurse: hi I'm **

Learner 1: hiya nice to meet you. So we've been called to have a look at Levi and see how he's moving and getting about, is that right?

Nurse: yep, it's over to you guys. I'm here, I'm just doing some paperwork just things with his charts and stuff, but I can help do whatever you want, just shout me and I'll just be sat there. So over to you, yeah

Support from facilitator

Learner 1: and just when were his last obs taken?

Nurse: an hour ago, they're on there [points to chart at end of the bed]

Learner 1: they're on there?

Nurse: everything's on there for you. Dynamap's there for you, so if you need to take anything else it there but…erm, obs an hour ago, alright

Cue (environmental)

Learner 1: hi Levi, how are you doing?

Levi: hi, I'm fine thanks

Learner 1: we're the physios, my name is **

Introductions (comms skills)

Learner 2: I'm **

Learner 3: I'm **

Levi: ah, pleased to meet you

Learner 1: so we'll just check your obs first of all

Levi: yeah, I've been waiting for you because they said you were coming help me get out of bed today, so, I'm looking forward to it

Learner 2: so are you feeling ready?

Levi: I'm feeling very ready, yeah, I wanna get up, I wanna get back home

Cue (verbal)

Learner 2: when was the last time you were out of bed?

Levi: well, I was hoisted out this morning. I've not really been able to get out of bed myself, but you know, I've been really poorly

Learner 2: [nodding] okay

Levi: I used the hoist this morning is very, very

Learner 2: uncomfortable?

Levi: yeah

Learner 2: is it strange?

Levi: yeah, I don't like it really

Learner 2: and did you get hoisted into this standard chair?

Levi: I was put in that chair yeah

Learner 2: and were you comfortable in it, did you feel like you were supported?

Levi: huh?

Learner 2: were you supported enough in that chair?

Levi: er, yeah, yeah, it's alright once I'm sat in it, yeah

Learner 2: and how long did you sit out for?

Levi: it was only for about twenty minutes

Learner 2: okay, [to nurse] and then you had to hoist him and place him back in after that?

Nurse: only because we needed changing

Learner 2: okay

Nurse: so you'd have managed, he manages longer than that normally, he manages more than twenty minutes, but we just need it to do some changes and things

Learner 2: okay. Have you gotten any attachments?

Levi: attachments?

Learner 2: have you got a catheter or anything in?

Levi: I've got a bag, yeah

Learner 2: okay

Learners 1, 2 & 3: [huddle at the end of the bed]

Levi: so do you think you'll be able to get me out of bed then?

Learner 2: well, Levi, what we'll do is we'll just start off, have a look at you in the bed, just look at your power and some different things, erm, and go from there

Levi: I really want to start thinking about going home you know, cos I've been hospital for weeks now

Learner 2: yeah, that's what we wanted to do, we wanted to talk to you about your goals and how we're going to meet them

Learner 1: [looking through Levi's notes] this is looking quite good. Chest x-ray here

Cue (environmental)

Levi: does everything look all right?

Learner 3: yeah

Learner 1: I think you're looking quite good Levi

Learner 2: are you eating and drinking?

Levi: sorry?

Learner 2: are you eating and drinking okay at the moment?

Levi: yeah, yeah. It's fine. Yeah

Learner 2: okay. Right, so, if it's aright with you, I'm going to pull the covers back. Have you got trousers on?

Privacy & dignity

Levi: I've got trousers on, yes

Learner 2: am I alright to pull these covers back?

Levi: yeah, sure

Learner 2: in fact, we'll just wash our hands [Learners leave Levi's bed area to go wash hands at sink]

Patient safety (hygiene)

SimC (Paper-case)

Group 4 – 20min

Space: What is the physical space like?	A clinical environment with white table and two chairs
Actors: Who is involved?	Two student learners
Goals: What do they want to accomplish?	Overall goal: Develop, justify and apply management strategies for specific patients in real-time in simulated situations
Objects: What objects are present?	Papers on the table, pens, one table and two chairs, windows visible
Event: What kind of event is it?	A simulated home visit (paper case) by healthcare professionals (Physios)

Facilitator: this is your paper case study, so if you want to read and discuss that, your time you've got twenty minutes to do the simulation, write any notes on that paper and I'll have to collect that at the end. Okay, any questions?

Learner 1: no

Facilitator: good luck, thank you very much

Learner 2: [incoherent]

Learner 1: [to Learner 2] can you see?

Learner 2: yeah

Learner 1: [to Learner 3] can you see?

Supporting each other

Learner 3: [smiling]

Learner 1: okay

Learner 2: [moves chair to other side of the table]

Learner 1: so, it's about Levi, scenario is cardio respiratory physiotherapy [reads from paper case] he's 61 year old man, lives with his wife, ah, in Oldham, okay. He's a father of two children aged twenty-three and thirty, both of the children left the family home after they returned from studying at university. He's very lively and very caring, he is passionate about dogs and animals [incoherent]. So now this is the patients home, the location, ah, history is has been referred to the community physiotherapy service following discharge from critical care. The referral letter explains that Mr Williams has multiple sclerosis

Learner 2: okay

Learner 1: and a history of recurrent urinary tract infections, recent aspirations resulting in ventilation and twenty-nine days in the hospital, yeah, and he has low tone upper, lower and thorax, upper limbs, lower limbs and thorax, this is new, other day it was only the lower limbs. He has restrictive thoracic movement in particularly extension. Upon discharge, the physiotherapist recommended moving and handling with assistance of one from bed to chair or wheelchair. He is currently sleeping in the living room and has a commode. When you arrive at the patient's home you find Mr Williams sat in the living room. Levi's wife, Alana, answers the door and informs you that she is worried about his mobility and low mood. Before leaving to, ah, walk Sadie the dog, she reports that Levi is more tired than usual, he still cannot use the stairs, although he is constantly trying to, asking to try on his own so he can sleep in the bedroom upstairs and have a bath. Alright, so the GP recognises he has multiple sclerosis

Confusion: abbreviations - lack of knowledge/understanding (nobody to ask for help)

Learner 2: okay

Learner 1: ah, condition is rehabilitation post discharge from critical care. What's MRSA?
Learner 3: M-R-S-A? Can we check it?
Learner 1: yeah we can do that. There is no cough, there's a urinary catheter, he has no allergies. He's on Interferon Beta 1a, for relapsing multiple sclerosis
Learner 2: okay, there's a need for…[incoherent]
Learner 1: and Tizanidine for muscle spasms. Alright? [turns the page over] there's learning outcomes, okay, these are some learning outcomes, we will be able to do
Learner 2: [reads from paper case] blood pressure, gloves, aprons, there's a stethoscope for the respiratory…
Learner 3: [reads from paper case] there are three parts you have twenty minutes to complete your assessment
Learner 1: yeah, consider the events
Learner 3:…prompts provided
Learner 1: prompts provided
Learners 3 &1: write down in the table provided any actions that you would undertake if you were the…
Learner 1: okay, alright, so, assume that we have a bag with us right now
Learner 2: okay
Learner 1: with a BP monitor, saturations probe, gloves, aprons…slide sheet
Learner 1: [turns page] right, then, yeah, first there's initial physiotherapy assessment, now they are saying that his respiratory rate is fourteen
Learner 2: yeah his resps
Learner 1: yes, his heart rate is eighty-two, which is okay, his blood pressure is one twenty five by eighty two
Learner 2: normal, okay
Learner 1: ah, his SPO2 is ninety-seven, that's okay
Learner 2: okay
Learner 1: temperature is thirty-six point nine
Learner 2: slightly high
Learner 1: breath sounds are normal, there are no added sounds, ah, there's a sinus type of cardiac rhythm, ah, bowel sounds are normal, he's lethargic and weak, the tone is low in the upper and the lower limbs and around the trunk, and his pupils are pearl

Confusion: phys obs - lack of knowledge/understanding (nobody to ask for help)

Learner 2: okay
Learner 1: and they've given A to E assessment also
Learner 3: the airway

Learner 1: the airway is patent, self-ventilating, no cyanosis, breathing is good expansion, all the areas, no accessory muscle use, no increased work of breathing, normal breath sounds, cough is adequate. Circulation, the skin is pale, warm, CRT is…erm? CRT is what? I know it
Learner 3: cardiac re…
Learner 1: two seconds [to Learner 2] You know what CRT is?
Learner 2: it's circulation
Learner 1 & 3: [laughing] alright. UO?
Learner 2: I just read the heading, circulation

Confusion: abbreviations - lack of knowledge/understanding (nobody to ask for help)

Appendix N: Reflexive thematic analysis approach

<u>Step one: Familiarisation with the data</u>

Sim A (Manikin)

Coding

Positive experiences

- Introducing self (3/4 groups)
- Consent (4/4 groups)
- Teamwork (2/4 groups)
- Decision making (4/4 groups)
- Assertive language and behaviours (3/4 groups)
- Explaining to patient (4/4 groups)
- Escalating concerns (2/4 groups)
- Systematic approach (A-E) (1/4 groups)
- Patient centred approach (4/4 groups)
- Recognising own limitations and need for MDT (2/4 groups)
- Recognising deterioration and need to escalate (2/4 groups)
- Overcoming difficulties (2/4 groups)

Gathering information

- Asking questions (4/4 groups)
- Clarifying (4/4 groups)
- Requesting help/seeking assistance (3/4 groups)

Prompting

- By manikin (4/4 groups)
- By facilitator (4/4 groups)
- By monitor (4/4 groups)
- Acknowledging and responding to prompts (4/4 groups)

Negative experiences

Lack of equipment (pen, stethoscope) (2/4 groups)

Lack of introduction (1/4 groups)

Incorrect moving and handling (1/4 groups)

Use of technical language (1/4 groups)

Equipment fidelity (1/4 groups)

Use of non-assertive language/giving patient options…'shall we…' (1/4 groups)

Confusion (1/4 groups)

Not recognising deterioration and need to escalate (2/4 groups)

Word cloud (Manikin scenario)

Sim B (Human SP)

Coding

Positive communications

- Introducing self (3/4 groups)
- Consent (4/4 groups)
- Dignity (3/4 groups)
- Encouragement (4/4 groups)
- Explaining (4/4 groups)
- Making jokes (1/4 groups)
- Small talk (1/4 groups)
- Therapeutic touch (1/4 groups)
- Teamwork (4/4 groups)
- Reassurance (1/4 groups)
- Promoting independence (1/4 groups)
- Patient safety (2/4 groups)
- Leadership (1/4 groups)

Gathering information

- Asking questions (4/4 groups)
- Clarifying (4/4 groups)
- Seeking help/assistance (3/4 groups)
- Discussing options (1/4 groups)

Prompting

- By human SP (4/4 groups)
- By facilitator (4/4 groups)
- Acknowledging and responding to prompts (4/4 groups)

Negative experiences

Miscommunication (1/4 groups)

Lack of introduction (1/4 groups)

Unprepared (2/4 groups)

Lack of clarity (4/4 groups)

Use of non-assertive language/giving patient options…'shall we…' (2/4 groups)

Confusion (2/4 groups)

Psychological fidelity (1/4 groups)

Word cloud (Human SP scenario)

Sim C (Paper case)

Coding

Positive communications

- Consent (2/4 groups)
- Teamwork (4/4 groups)
- Promoting independence (1/4 groups)
- Patient safety (2/4 groups)
- Safeguarding (4/4 groups)
- Concern (1/4 groups)
- Problem-solving (3/4 groups)
- Discussing actions (4/4 groups)
- Recognising own limitations (3/4 groups)
- Buy-in (2/4 groups)
- Person-centred care (2/4 groups)

Prompting

- By paper case

Gathering information

- Asking questions (4/4 groups)
- Clarifying (4/4 groups)
- Discussing options (1/4 groups)
- Recognising own limitations and need for MDT (1/4 groups)

Negative experiences

- Unsure (4/4 groups)
- Confusion (3/4 groups)
- Lack of Facilitation/support (3/4 groups)
- Disengagement (2/4 groups)

Going off-topic (1/4 groups)

Knowledge deficit (1/4 groups)

Silence

Word cloud (Paper-case)

Step two: Generating initial codes

SimA (Manikin)

	Environmental	Personal		Behavioural
	Prompting	Positive experiences	Negative experiences	Gathering information
SimA (Manikin)	By manikin	Introducing self	Lack of equipment	Asking questions
	By facilitator	Teamwork	Lack of introduction	Clarifying
	By monitor	Decision making	Incorrect moving and handling	Requesting help/ seeking assistance
	Acknowledging and responding to prompts	Assertive language and behaviours	Use of technical language	
		Explaining to patient	Equipment fidelity	
		Escalating concerns	Use of non-assertive language	
		Systematic approach (A-E)	Confusion	
		Patient centred approach	Not recognising deterioration and need to escalate	
		Recognising own limitations and need for MDT		
		Recognising deterioration and need to escalate		
		Overcoming difficulties		

(yellow)	Communication skills
(green)	Situational awareness
(pink)	Technical skills

SimB (Human SP)

	Environmental	Personal		Behavioural
	Prompting	Positive experiences	Negative experiences	Gathering information
SimB (Human SP)	By human SP	Introducing self	Miscommunication	Asking questions
	By facilitator	Consent	Lack of introduction	Clarifying
	By monitor and patient notes	Dignity	Being unprepared	Requesting help/ seeking assistance
	Acknowledging and responding to prompts	Encouragement	Lack of clarity	Discussing options
		Explaining to patient	Use of non-assertive language	
		Making jokes	Confusion	
		Small talk	Psychological fidelity	
		Therapeutic touch		
		Teamwork		
		Reassurance		
		Promoting independence		
		Patient safety		
		Leadership		

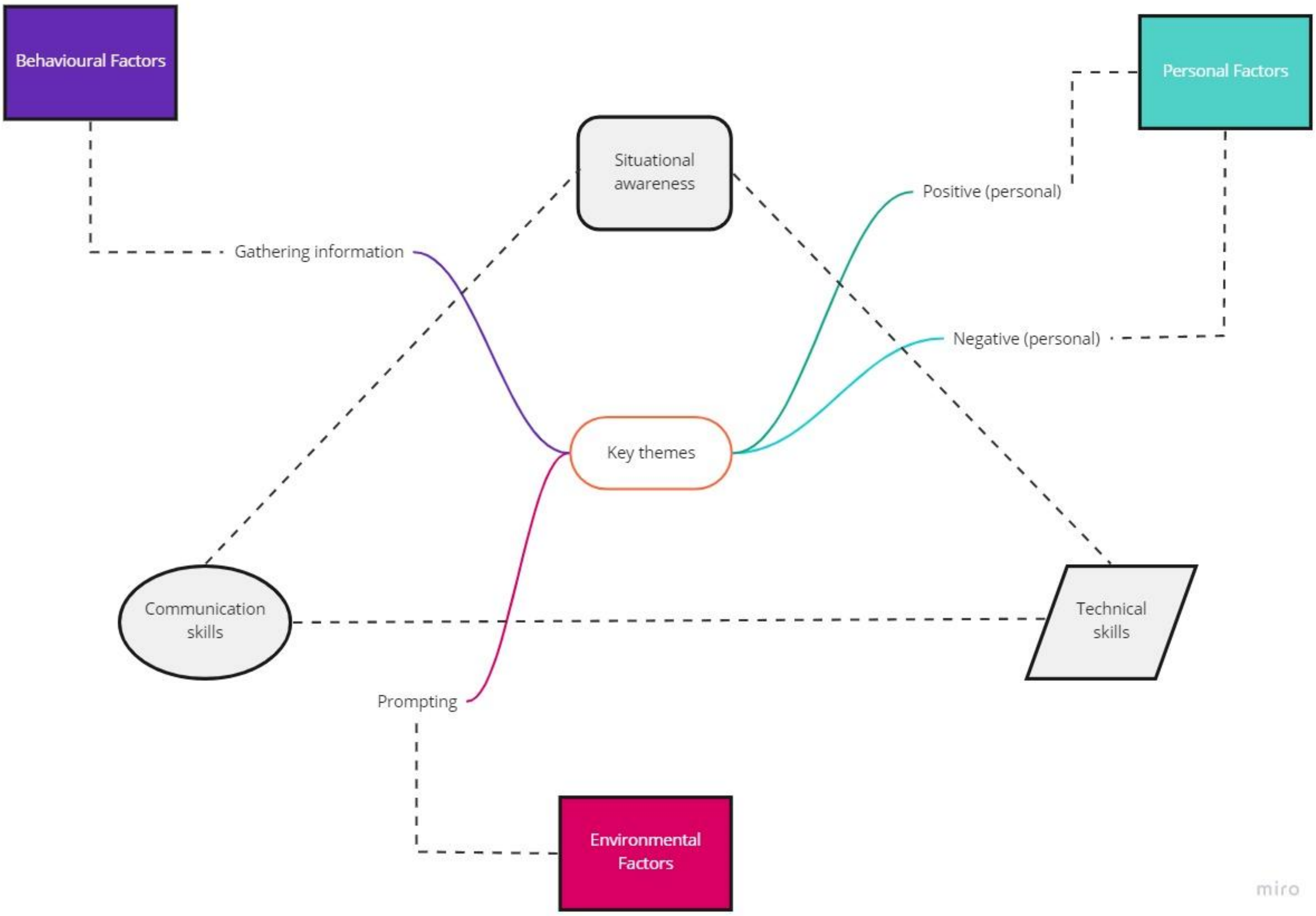
(yellow)	Communication skills
(green)	Situational awareness
(pink)	Technical skills

SimC (Paper case)

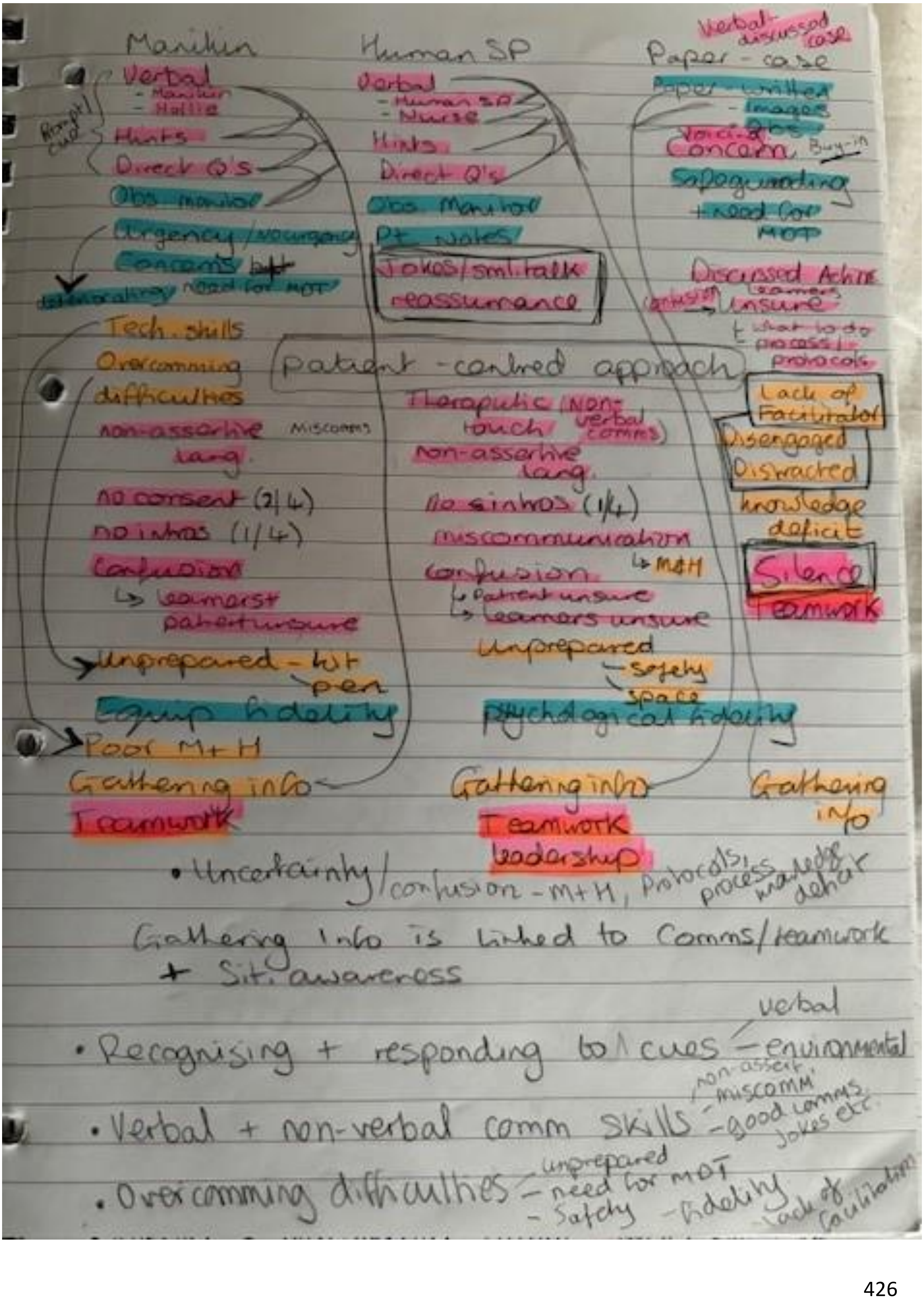
	Environmental	Personal		Behavioural
	Prompting	Positive experiences	Negative experiences	Gathering information
SimC (Paper case)	By paper case	Consent	Unsure	Asking questions
		Teamwork	Confusion	Clarifying
		Promoting independence	Lack of facilitation/support	Discussing options
		Patient safety	Disengagement	Recognising own limitations and need for MDT
		Safeguarding	Going off topic	
		Concern	Knowledge deficit	
		Problem-solving	Silence	
		Discussing actions		
		Recognising own limitations		
		Buy-in		
		Person-centred care		

(yellow)	Communication skills
(green)	Situational awareness
(pink)	Technical skills

Initial mind map linked to Bandura's Social Learning Theory and SPLINTS Categories

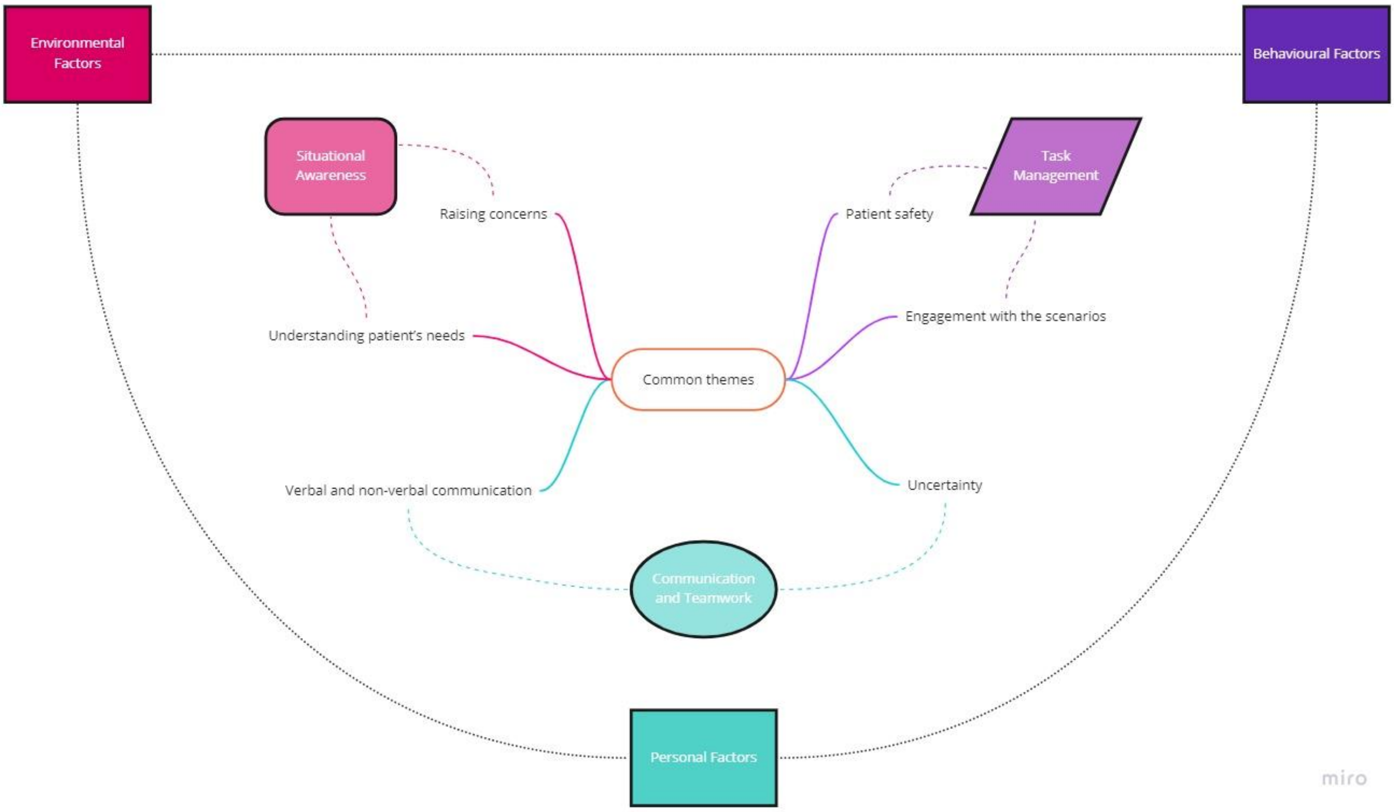


Step three: Searching for themes



Step four: Reviewing themes

Interim mind-map



Step five: Defining and naming themes

Six common themes and seventeen sub-themes are listed on Page 176 and illustrated in Figure 6-1 and Figure 6-2

Step six: Producing the report

Findings are presented with data extracts in Chapter 6