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PRAXIS Project Number

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PRAXIS Project: Final Report

Simulation: informing and enhancing curriculum in Health, Wellbeing and Social Care

Wendy Turner, Bob Hallawell and Sharif Haider

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Abstract

Simulation is a rapidly growing aspect of teaching, learning and assessment across HE. Simulation replaces real experiences with online learning opportunities that (seek to) replicate the real world, in a way that is immersive and interactive. As a teaching tool, simulation pedagogy relates to three levels:

- Learning object – a simulation which is suitable for multiple contexts to be adopted unused.
- Adaptable simulation – a simulation which need adaption to fit the context
- Bespoke simulation – created for a particular context.

Further, simulation helps resolve practical dilemmas and mitigate ethical tensions, of experiential learning in HE. Utilising alternative experiential teaching tools in HE, has become increasingly urgent, given the HE experiences of 2020 and Covid 19.

The School of Health, Wellbeing and Social Care (HWSC) has not yet fully exploited the use of bespoke simulation within its curriculum, rather it has borrowed or adapted simulation to fit into teaching content.

Simulation in higher education, as an applied pedagogy for HWSC, has the potential to offer students a chance to learn from simulated real-world situations. Initial research shows that simulation enhances academic achievements, experiences and student satisfaction.

This project sought to identify what the different types of simulation are, for and to identify how simulation might be used to enhance the HWSC curriculum.

Overall, the research project found the commonly used simulation methodology and tools utilised within the health and social care were **web-based simulation scenarios, computer based simulation, human/patient simulators, virtual reality and hybrid simulation.** Skilled facilitation of simulated learning, through design and delivery, was shown to improve student satisfaction, outcomes and the overall learning experiences.

The underpinning pedagogies were active teaching methodologies, such as incrementally developed and **scaffolded experiential learning** which enabled an **immersive learning experience** for the student. A key message was that simulated learning should be designed **into** the learning rather than **added on.**

Within health and social care higher education, commonly, simulation was used to prepare students for real-life practice. For example, preparation for practice with service users, such as in their home, or practice of clinical skills within healthcare settings.

As a creative and innovative HE pedagogy, simulated learning offers us, the Open University, an exciting opportunity to embrace this as a teaching approach, with stable functions and tools, to enhance our student offer, enrich the student experience and progress outcomes, within the field of HWSC HE.

Introduction

Why we chose the project

Our changing society and post-lockdown way of living have collided to catapult the place of simulated learning in health and social care education to the forefront.

In educating the professionals of the future, we must equip them with technological knowledge and a strong digital skill set. Coupled with the need to learn, practice and execute skills-based competencies, simulated learning offers a real option to enhance our traditional educational approaches.

Further factors play into this online digital landscape: the emergent urgency to find and sustain increasing student placements in health and social care settings, sufficient mentors and supervisors to oversee these placements,

increased logistical issues in accessing real settings and, the lessons we are learning from 'lockdown' learning and the new ways of working and delivering care to people.

Aul et al (2021) drawing from the INACSL Standards Committee (2016b) defines simulation (education) as, *"a broad array of structured activities that represent actual or potential situations in education, practice, and research" (p. S45)* p1.

Why we chose methodology – how Covid 19 has changed what we do.

The project team discussed visiting and viewing simulated learning exemplars situated across higher education, for example, healthcare simulation suites. However, the context of the project was to consider simulated learning *online* and how this can enhance our distance learning delivery of higher education. Thus, we settled upon a systematic review of the research base and outcomes these exemplars.

This project also coincided with National lockdowns 2020 onwards, and so the whole project was undertaken virtually. This complimented the nature of the project as online education and delivery.

Mapping against health and social care standards and regulation

The project team explored how the various UK regulatory bodies for health and social care have embraced simulated learning in several ways.

Firstly, to enhance and fill gaps within practice placement /experience opportunities. Many factors impact on students' opportunity to gain access to real-life learning experiences, such as lack of student placement capacity and supervisory capacity, difficult-to-source opportunities, logistical difficulties, disparities of opportunity. All regulators see simulated learning as a way to bridge these gaps and ensure parity of learning experiences for students.

Simulated learning allows student to be supported safely to prepare for practice experiences. Simulated learning was seen as a safe teaching approach for many clinical and soft skill development for health and social care students. As a re-usable teaching tool, students and tutors are able to repeat, revise and examine students, ready for practice or returning to practice.

Regulatory and educational bodies see simulated learning as tool for contemporary higher and technical education, preparation and practice for students. Notwithstanding, is the learning from our experiences through lockdown 2020. This has fundamentally changed how health and social care is planned and delivered. Further, technological changes in society, such as digitalisation and ways of working, simulated consultation, and use of technology and technological skills, are now key strands of health and social care. Simulated learning offers a sustainable pedagogical approach to educate and prepare our future health and social care professionals.

Contribution to HWSC

This project directly contributes to the pedagogic approaches and decision making in the learning design of HWSC higher education. The findings, conclusions and recommendations demonstrate *how* simulated learning can enhance health and social care distance learning through the contemporary lens of our changing society and emergent societal health and social care needs.

The project - research questions were:

1. How might the OU develop the HSC curriculum, **to make best use of simulation, as a collaborative methodology, for teaching, learning and assessment**?
2. What might be the **impact of simulation be for the student experience and outcomes**?

And from the questions the team identified 4 aims to:

1. Understand and define simulation within the HSC curriculum through systematic literature review and understanding the student experience and outcomes.
2. Understand how simulation fits into the teaching, learning and assessment agenda of the regulatory bodies (associated with HSC) and HE delivery.
3. Be cognisant of simulation curriculum and simulation development at the OU, and how we should align HSC simulation with the OU and Faculty strategy
4. Report on and recommend future planning of simulation with the HSC curriculum.

Literature review

Pedagogical purposes of simulation in HE.

As a pedagogy, simulation in higher education opens up educational opportunities to students to learn, practice and master complex practical skills. Simulation education is becoming common in higher education. particularly in STEM subjects (Wu, Anderson, 2015). Simulation recreates the real-world and allows students to experience and learn from that real-world (Usherwood, HEA, 2015). From Usherwood's premise of simulation, there is a clear application for simulation to be more creatively utilised in health and social care (H&SC) education.

Simulation learning is beginning to show that it improves *confidence, competence and self-efficacy* for students (Cant, Cooper, 2017) and increasingly simulation is being used as a creative way to assess technical-based health and social care skills and competencies. Further, embedded as part of the whole curriculum (Gordon et al, 2016), simulation offers an innovative and safe multimodal educational experience for H&SC students.

Educational outcomes

Simulation is understood to help facilitate deeper learning, understanding concepts and relationships such as advanced inquiry and decision making (Gordon et al, 2016). It is a way to '*scaffold effective learning*' (Chernikova et al, 2020:499) through authentic experiences as real-life experiential learning is increasing limited. Previous literature shows that simulation positively influences student knowledge transfer, skills acquisition, enhances digital and

technological skills (Pellas et al, 2016, Gordon et al, 2016). Further findings suggest that moving across simulation platforms enables students to manage learning materials efficiently through their course of study (Cant, Cooper, 2017) contributing positively to their achievements.

Policy and regulatory drivers

Simulation education is seen to deliver *patient- centred, high quality educational outcomes* (Health Education England (HEE), 2019). Following from the Topol Review (2017) which recommended '*NHS staff to make the most of innovative technologies such as genomics, digital medicine, artificial intelligence and robotics to improve services*', HEE (2019) has set out a national strategy around equity of access to simulation education and training, which is replicated by all UK Nations health educational boards / bodies.

Experience at the Open University

Haider (OU, 2018, 2019) carried out studies on HSC education related to computer simulation for interprofessional learning (IPL) and social work. These studies, carried out with practice partners from health and social care, found that there is a need for HWSC to explore simulation within its curriculum. The benefits were found to be that simulation facilitates learning opportunities that are 'immersive' and 'related to contemporary practice', and offering learning as the 'right support, right time and place'.
This knowledge should be expanded upon to help us understand how simulation, in its many forms, can be utilised within HSC curriculum to enhance teaching, learning and assessment and the student experience as a whole.

Methodology

Systematic review

A systematic review of a body of knowledge is not something new; the health care sector has been undertaking doing a systematic review for some time now. The Cochrane Collaboration (Sheldon and Chalmers, 1994) have shown us how to systematically review a body of knowledge in health care; they developed a framework as to how one can systematically carry out a systematic review which is now well-established. Over the last two decades, systematic reviews have started to gain momentum and popularity in the education sector. According to McDonald (2000) systematic reviews of research '*entail a series of techniques for minimising bias and error, primarily through the use of protocols which state, prior to the review being undertaken, what the criteria are which will guide the review, search strategies, inclusion and exclusion criteria, standards of methodological adequacy, the precise definition of the intervention in question, unbiased estimation of aggregate effect, and so on*.' (P. 131)

So, the key feature of a systematic review is to have specific research questions that need to be answered by searching and synthesising evidence, based on clear inclusion and exclusion criteria. The main thrust of doing a systematic review is to follow a rigorous and predefined process, structure and method to ensure that the generated evidence is reliable, robust and meaningful which could inform practice, policy and future research.

This study embarked on a systematic review to confirm or refute whether online simulations could support health and social care students' learning and development. One of the main aims of this project was to establish the quality of evidence and understand the way this pedagogical tool could be integrated and incorporated into health and social care modules at the OU.

Narrative Analysis / Thematic analysis

Our analysis protocol sets out:

- *We will seek to systematically summarise key features of included evidence (e.g. type of evidence; year of "publication"; geographical area; population).*

This is completed through the search and shifting of suitable literature using the '**characteristics and extraction table' (Popay et al, 2006)** (appendix 1)

- In terms of the integration of the findings / content of included evidence, it is likely that we will first of all synthesis findings / messages according to the specific type of evidence. We will then seek to identify overarching themes according to the essential meaning of the collective body of evidence, however derived and expressed.

This is completed using **Reflective Thematic Analysis (Braun and Clarke 2016)** through their 6 point process of i) Familiarisation with the data ii) Coding iii) Generating initial themes iv) Reviewing themes v) Defining and naming vi) Writing up

- Synthesis of findings / content of included evidence will draw on expert guidance on the conduct of **thematic analysis in systematic reviews (Ryan, 2013**) commonly used when evidence is derived from studies using a range of research designs and methods and where the exploration relates not only the effectiveness of interventions but also to answering a wide range of other questions, such as those about the implementation of interventions, efficacy, appropriateness and feasibility. The analysis will explore the relationship and findings both within and between the included studies, in line with the guidance from the Centre for Reviews and Dissemination (CRD, 2009).

This was carried out as part of the critical literature review using RTA frameworks and narrative review (Ryan et al, 2019)

- To promote rigor, drafts will be shared with the review team, who will provide feedback on fit with the original data, as well as overall sense and insight provided. This process will enable the production of an analysis, which has benefited from the input of a range of expert knowledge and understandings.

This will be enabled through shared meetings and review of findings across Aug 2021

- A study characteristics and findings table will be populated,(appendix 2) collating data such as; reference details, details of the intervention, participants, setting and context, outcomes, methods and quality.

As noted above using **Popay et al, 2006.**

Taken from Ryan et al 2019: *(in italics)*

- *Additionally, even where meta-analysis is used, the results need to be described and integrated in the text of the review. A narrative synthesis can provide a first step in looking systematically at, and organising, the data.*

This is part of our collation of data using Popay et al 2006 characteristics table

- *At review stage, authors will make further decisions about how best to organise and present the data based on the actual review findings. While it may be possible or necessary to make some changes to the synthesis approach after the protocol has been developed, thinking through and planning the approach at protocol stage is still very important, and changes made at later stages of the review may need to be justified in terms of a rationale for making changes.*

We have settled on using Popay's table as a record of key characteristics and then move to reflexive thematic analysis (Braun & Clarke, 2006, 2019) of coding, themes and analysis.

- *We encourage authors to attempt a narrative synthesis that includes investigation of the similarities and the differences between the findings of different studies, as well as exploration of patterns in the data. For example, considering the results of studies of different design (eg. RCTs and non-RCTs), or with different forms of intervention implementation or delivery, could be ways to approach the synthesis.* ***Reasons for both similarities and differences in the findings should also be explored systematically, with possible explanations for the pattern of results considered in a logical way for each of the included studies.***

We will do this as part of our shared discussion of readings and findings and document these discussions and decision making

The guidelines describe four major steps for **narrative synthesis** in reviews of effectiveness questions, as follows.

1. **Developing a theory of how the intervention works, why and for whom**
2. **Developing a preliminary synthesis of the findings of included studies**
3. **Exploring relationships in the data within and between studies**
4. **Assessing the robustness of the synthesis**

In addition: this is our justification / choice of thematic analysis

Braun & Clarke (2006, 2019)

Reflexive Thematic Analysis (we will sit this within our narrative analysis)

- **An inductive way – coding and theme development are directed by the content of the data;**
- A deductive way – coding and theme development are directed by existing concepts or ideas;
- **A semantic way – coding and theme development reflect the explicit content of the data;**
- A latent way – coding and theme development report concepts and assumptions underpinning the data;

- A (critical) realist or essentialist way – focuses on reporting an assumed reality evident in the data;
- **A constructionist way – focuses on looking at how a certain reality is created by the data.**

And we followed Braun & Clarke's (2006 / 2019) 6 steps to thematic analysis

- **Familiarisation with the data |** This phase involves reading and re-reading the data, to become immersed and intimately familiar with its content.
- **Coding |** This phase involves generating succinct labels (codes!) that identify important features of the data that might be relevant to answering the research question. It involves coding the entire dataset, and after that, collating all the codes and all relevant data extracts, together for later stages of analysis.
- **Generating initial themes |** This phase involves examining the codes and collated data to identify significant broader patterns of meaning (potential themes). It then involves collating data relevant to each candidate theme, so that you can work with the data and review the viability of each candidate theme.
- **Reviewing themes |** This phase involves checking the candidate themes against the dataset, to determine that they tell a convincing story of the data, and one that answers the research question. In this phase, themes are typically refined, which sometimes involves them being split, combined, or discarded. In our TA approach, themes are defined as pattern of shared meaning underpinned by a central concept or idea.
- **Defining and naming themes |** This phase involves developing a detailed analysis of each theme, working out the scope and focus of each theme, determining the 'story' of each. It also involves deciding on an informative name for each theme.

- **Writing up |** This final phase involves weaving together the analytic narrative and data extracts and contextualising the analysis in relation to existing literature.

How we undertook the Systematic Review

The search strategy. A broad range of evidence was reviewed including research articles, reports and guidelines relating to simulation in health and social care teaching, learning and assessment. Within the published research we included primary (using quantitative, qualitative and mixed methods) evidence and secondary (review) level evidence was used as background material.

Given our time and other resource constraints, we only included literature written in English and evidence made available after 1997. The setting for studies was limited to higher education, which encompassed the experiences of educators and students.

A pilot search was conducted with the support of an experienced librarian within the Scopus database using the search string at Appendix 3.

A wider search was then conducted in the CINAHL, Social Care Online, Scopus, Web of Science, PsycINFO, and BNI databases. Due to the large number of initial records (4014) further filters were applied relating to duplicates, peer reviewed sources and online simulation only.

Records were screened by a single reviewer using titles and abstracts. Full text sources were then accessed and screened using the additional filters. The search results were detailed in a flow diagram (Appendix 5 – Flow diagram for database search). The Mendeley reference management system was used to store search results. Data were then extracted from the records by three reviewers and compiled into a characteristics and extraction table (Appendix 1) to include publication details, demographic information, methodology, intervention details, and all reported outcomes.

Reliability and verification

Following our systematic review methodology, our protocol included the need for independent verification and inter-reliability check. This was undertaken through independent peer review of the analytical aspect of the systematic review. It included review of the individual team coding process and the team review of our thematic approaches, identification of key themes and clustering of these themes.

Findings

What we did (introduction)

The systematic reviewed identified 55 papers. We randomly allocated the papers between the research team and independently reviewed these using an adapted thematic analysis table (appendix 3, Turner 2021, from Braun and Clarke 2016). The papers included mixed data and so took a combined approach of thematic (Braun & Clarke) and narrative analysis (Ryan, 2013) allowing codes and themes to inductively emerge.

In reading and understanding the papers and data, the team referred to Tait et al (2018), mixed approach to thematic and narrative synthesis (appendix 2) the team reviewed the papers exploring the data and effectiveness questions, as:

- Developing a theory of how the intervention works, why and for whom (simulated education)

- Developing a preliminary synthesis of the findings of included studies
- Exploring relationships in the data within and between studies
- Assessing the robustness of the synthesis

Process

Independently the research team identified codes derived from the reading (see appendix 4). These codes were evaluated and agreed as **basic themes (codes)**. Informed by thematic and narrative analysis noted above, Turner (2021) created an adapted table: Thematic Analysis Table (appendix 2). This enabled the inductive development and evaluation of the data through a shared recording of the independent reading.

The table allowed the team to then identify and match **global themes,** drawn from the research question, and these were further discussed as **organising themes,** identified from both the readings and matched to the research aims. Further narration (detailed notes and key points / ideas) was captured in the table from the reading and examples that illustrated the coding, organising and global themes. This table can be seen in appendix 2

Further to the evaluative table, as a clear record of review and coding the team independently updated and kept records of their readings and findings using Popay et al's (2006) *characteristics and extraction table* (appendix 1). To link both tables, the team added a 'note / further narration' column to Popay's table.

The research team meet and used the tables as a record of findings, codes and evaluative notations. The team were then able to discuss the codes, organising themes and global themes, addressing the research question, aims and output. The discussion drew from the reading, other related research materials (collected onto the shared research space), and our professional experiences of simulated learning from academic theory and practice. Codes were derived and grouped into themes (appendix 6) with a discussion of the definition of these themes and drawing on the narrated evidence.

This formed the initial analytical framework. The next step was then a reader who independently took a random sample review of the readings, increasing the triangulation methodology of the data analysis. This step of the process revised the initial framework to incorporate new and refined codes (appendix 6 and 7).

Limitations

Due to the volume and quantity of research papers from the systematic review search and from the initial pilot and review of these papers, the team elected to review the articles only. A pragmatic decision was made that the quality and methodology was acceptable for the study. This decision was made on the basis that the selected papers fitted the criteria of:

a. The search parameters (peer reviewed research data bases only)
b. Methodology (gathering measurable / mixed data)
c. The scoping protocol filtered unsuitable papers (appendix 8 and 9)

Papers that will be utilised in any further publications from the team will be subjected to more rigorous systematic review scrutiny (as seen in the protocol appendix 8)

Deriving the themes.

An **independent reviewer,** in line with the systematic protocol, examined the review, choices on coding and how the themes have derived from this. The reviewer noted that:

- *' the codes are exhaustive and the review process has not missed anything. All seems to be there'.*
- *'I would wonder whether for easier orientation – it would benefit from the codes to be clustered. This would be helpful perhaps for writing up the findings with common themes and as supplementary material for the reviewers. It is something that could be added to appendices for the reader to see how thoroughly the analysis was done'.*

As part of the thematic analysis, and following on with a narrative approach, the review team have clustered the codes and themes. This can be seen in appendices 2, 6, 7

With the research questions in mind

Research question:

1. *How might the OU develop the HSC curriculum,* ***to make best use of simulation, as a collaborative methodology, for teaching, learning and assessment****?*
2. *What might be the* ***impact of simulation be for the student experience and outcomes****?*

the following themes were identified.

Themes:

Functions of simulated learning and pedagogy

- Substantive
- Authentic
- Designed with learning outcomes in mind

Pedagogy and methodology (of simulated learning)

- Learning design
- Simulated learning pedagogy (in HE) and enhancing study
- Teaching (tool)

1) Assessment

Impact for student experiences and outcomes

- Learning experience
- Knowledge and skills development
- Experience of simulated learning and impact on learning
- Student workload
- Assessment

Simulated practice

- Safety
- Replicated practice
- Replacement of practice

The **aims of the project** (drawn from the questions) were:

1. Understand and define simulation within the HSC curriculum through systematic literature review and understanding the student experience and outcomes.
2. Understand how simulation fits into the teaching, learning and assessment agenda of the regulatory bodies (associated with HSC) and HE delivery.
3. Be cognisant of simulation curriculum and simulation development at the OU, and how we should align HSC simulation with the OU and Faculty strategy
4. Report on and recommend future planning of simulation with the HSC curriculum.

Discussion

This discussion is set out in three parts. Firstly, our findings of simulated learning for higher education in health and social care education. How the project team have addressed the aims of the project. Lastly, our conclusions drawn from the project findings and the recommendations made from this.

Functions of simulated learning and pedagogy

Simulation experiences provide students with a safe and realistic backdrop to practice mostly soft skills. Medium and high-fidelity simulations can be an effective teaching and learning method as long as the design is realistic to health and social care practice. A number of research studies found that computer-mediated simulation and VR simulation provide close to the real-life experience to students, especially if such simulations have haptic properties that provide immediacy of feedback. For example, several research studies have indicated that students found virtual patients and the interactions with patients were presented in a realistic manner and provided realistic learning opportunities (e.g., Turrise et al., 2020). Probably for this reason they fully engaged with simulations.

Furthermore, Liaw et al's (2020) study have suggested that VR simulation about interprofessional rounds enabled students to delve deeper to understand the roles of members in interprofessional teams. Due to the real-life experience provided by the VR simulation students realised and appreciated the significance of working together to foster person-centred care in hospitals. Also, with the support of the simulation, they understood how they could work together and its impact on patients. The promotion of teamwork was a manifest theme in a number of simulation modalities According to them, 'different health care students expressed that gaining deeper understandings of the different interprofessional roles of team members enabled them to have invaluable insights into how each complementary expertise can help address and fill a patient's needs' (P. 45). Also, the provision of holistic care could improve by working together; Liaw et al (2002) found the realistic design of the VR simulation enabled students to learn about each other roles and responsibilities and understand patients' perspectives from a different point of view. Also, this simulation allowed students to share their inputs during the interprofessional rounds which improved team-based care. However, this research study found although VR simulations aimed to provide an accurate picture of a real-world ward round there was variability in real-world practice.

Like Liaw et al's (2002) study Williams et al., 2020) also found that role clarification of interprofessional team members improves patients' outcomes because they can communicate effectively and work as a team (Williams et al., 2020). Sunnqvist et al. (2016) also added that simulations in particular virtual patient simulation in psychiatric care support collaborative learning. Learning together is vital to improving the ability of health and social care students to work together to improve patient care. Furthermore, using virtual patients could improve nurse-patient interaction if the design of VR simulation is authentic and realistic (Orr et al., 2021). Similarly, Ma et al. have (2021) suggested that a computer roleplaying game could also promote empathy due to its authentic design which should be aligned with the learning outcomes.

Pedagogy and methodology (of simulated learning)

Our review found that simulated learning fitted into pedagogic models of higher educational teaching and learning.

In the majority, simulated learning was aligned to Lave & Wenger's original social constructionist learning theory (1991), that simulated learning enabled a wider socio-cultural content (of the learning) so that the learning is contextually real (as possible) and therefore meaningful (Kourgiantakis T et al 2021). Mentioned is a range of the papers, this pedagogical stance also fits into theories of learning such as cognitive load theory and theory of deliberate practice (McDonald et al, 2021) and social learning theory (Tufford et al, 2021) which can effectively integrate repetitive, safe and complex learning into virtual simulations through a scaffolded approach.

Drawing from Kolb as experiential learning, simulated learning was found to '*connect intellectual knowledge to the spontaneous application of professional skills*' (Lee at al, 2021). Simulated learning *'facilitates learning of complex skills through scaffolding'* (Chernikova et al, 2020).

Key to delivery of these pedagogic theories of learning is *facilitation*. With little exception, the reviews highlight that facilitation of simulated education is essential (Aul et al, 2021, Blakeman 2019, Brewer & Barr, 2016). Facilitation, in the main, was carried out by tutors, as synchronous through curated simulated activities (Ferguson & Driver, 2019, Lee et al, 2021) and also as and also asynchronous as reusable learning activities. For example, in building a scenario, adaption to student responses and addressing learning gaps (Lanzieri et al 2021, Blakeman 2019). The resource requirement of direct facilitation can be mitigated by well-designed and planned simulations that empower student directed and active learning. These can have both scalability and repeatability. The faculty resource is then directed toward debriefing activity to underpin learning.

A substantial volume of the papers discussed or described the *function* of simulated learning as a technique of online learning that has the potential to replicate real situations and experiences, that '*enhances study'* (Bay et al, 2021).

As a teaching tool, simulation can enable a various learning approaches that '*matches student learning needs'* (Blakeman, 2019). For example, using simulation within assessment can '*mock real-life contexts'* which helps to ensure *'parity of (learning) experiences'* (Ferguson & Driver, 2019, Aul et al, 2021).

Other papers defined simulated learning within the methodology of teaching in higher education (social and health care) and noted how simulation should form part of the learning design of HE content. This is of particular significance to health and social care education and training in that simulation offers a way in which to tackle perennial issue of teaching across the practice- theory gap. It has been found to '*…increases skill and knowledge levels…bridges the practice-theory gap'* (Dodds et al 2018, Ferguson & Driver, 2019) because *'learning by doing is realistic and safe- free from consequences of mistakes'* (Kourgiantakis & Lee, 2020).

Impact for student experiences and outcomes

One of the main aims of using simulation in health and social care education is to enable students to put knowledge into their practice; some studies have shown that they were able to transfer the knowledge and skills they gained from engaging and involving in particular with simulations mostly medium and high-fidelity simulations. For example, students were able to transfer their interaction to the real patient effectively after attending a simulation exercise (e.g. Abram et al., 2021; Bonito, 2019; Sunnqvist et al., 2016). Also, it improved their confidence because they could practice their skills in a safe environment repeatedly. For example, Aul et al. (2021) found when simulations were repeated more than once in consecutive years students' confidence was improved. They also found

that it is possible to replace clinical hours up to 50% for prelicensure nursing students effectively. In contrast, a systematic review by Tait et al. (2018) found that simulation-based training did not appear to have a significant impact on overall clinical competence. However, students' knowledge of interprofessional competencies appears to be improved by using VR simulations (Williams et al., 2020).

A research study by Padilha et al. (2019) has suggested that clinical virtual simulation improved knowledge retention and initial clinical reasoning over time (2 months). They recorded a 20.4% improvement in students' knowledge retention and initial reasoning. Also, they found by using virtual simulations students' levels of knowledge and

satisfaction of the learning process improved which is consistent with findings from Tschannen et al., (2012), Sperl-Hillen et al., (2014) and Tiffany et al. (2016).

Both virtual simulations and standardized patients could enhance students' communication skills, ability to respond to an unpredictable event, reasoning and decision-making skills (e.g., Tiffany and Hogland, 2016; Washburn et al. 2021); students' critical thinking skills also improved because of simulations. Research on telehealth SBE has suggested that students critical thinking and clinical judgement skills improved when they dealt with crises (e.g., Abram et al., 2021).

Simulated practice

Safety

Safety was a key word that featured in many of the papers, and drew from the review, findings and recommendations of the papers.

Safety was seen through several paradigms as the learning environment, replicated learning, and replacement of practice.

The learning environment

a. Safety of learning online: vicarious learning.

Coded findings indicated that some students found simulated learning allowed them the opportunity to observe, reflect and learn, not just from the content, but also from the learning environment. This aligns to online learner typology, more specifically, Hill (2013) identified this a 'lurkers' with 4 lurker categories, all of which demonstrate participation with the educational experience. Honeychurch et al (2016) built from Hill's observations, were able to show the benefits of having student lurkers, interact in a different way *through observation* of how other students learning and interact: in effect is *vicarious learning* which equates to a *cognitive apprenticeship* (cited Honeychurch 2016 p2). This 'safety net' is enabled more readily online and should be a consideration within the learning design of simulated learning.

b. Safety of repetition / rehearsal.

The simulated learning to be repeated as many times as the learner require. The learner can go back and 'catch up', the learning can be 'saved' as a permanent learning asset. This builds in flexibility for the student and enables confidence building (in the skill / topic). Rehearsal of simulated learning topics can facilitate alternative outcomes and allows students to test out soft and clinical skill learning (Aul et al, 2021).

c. Safe to 'make mistakes'.

Findings indicated students felt able to test out and make mistakes in a simulated environment as the consequences were much less impactful for themselves, other colleagues, and service users (Ferguson & Driver, 2019, Bonito,

2019). This was not shown to dilute the learning experience, but rather to facilitate students in protected learning spaces (Lanzieri et al, 2021).

Replicated learning

a. Students can understand protocols/guidance, test out knowledge and refine skills *before* going into a real-life situation.

This promotes safe practice, develops confidence of the student

b. The public are protected from being recipients of *first-go* practice

Engenders public confidence in seeing / treated by 'a student' (Dodds et al, 2018)

Replacement of practice

a. Where there are difficult to source real-life experiences, simulated learning offers a safe alternative.

This might be because the experience is risky and incremental learning can mitigate the risk. Other real-life experiences (for learning) can be difficult to orchestrate, complex and sensitive for student presence, logistically challenging (McDonald et al, 2021).

b. Limited clinical learning opportunities.

Clinical / practice places in health and social care, are under enormous pressure due to increasing student numbers (Lee et al, 2021, Ferguson & Driver, 2019) and decreasing capacity for clinical / onsite direct supervision (Atack et al, 2009, Brown & Williams, 2009). Simulated learning offers safe learning opportunities where students can be supervised and coached away from placement, this alleviates capacity issues and safely plugs training gaps (HEE, 2021).

Part 2: address the aims in turn

The **aims of the project** (drawn from the questions) were:

1. Understand and define simulation within the HSC curriculum through systematic literature review and understanding the student experience and outcomes.

This was undertaken through systematic review and creation of a review protocol with independent verification.

2. Understand how simulation fits into the teaching, learning and assessment agenda of the regulatory bodies (associated with HSC) and HE delivery.

Simulated learning enhances and fill gaps within practice placement /experience opportunities, allowing students to access the learning they require and ensuring parity of learning experiences. Further, simulated learning allows student to be supported safely to prepare for practice experiences. The regulatory and educational bodies see simulated learning as tool for contemporary higher and technical education in preparing students for practice. Simulated learning offers a sustainable pedagogical approach to educate and prepare our future health and social care professionals.

3. Be cognisant of simulation curriculum and simulation development at the OU, and how we should align HSC simulation with the OU and Faculty strategy

We have been able to link into the OU wide Digital Strategy Group (DSG) and will report back findings to them. We have been part of the development of the HWSC and Faculty Unit Plans, within which simulation in the curriculum is identified as a growth area. This is supported by a simulation in the curriculum working group, set up by the project lead, identifying workstreams of scoping simulation, identifying gaps in educational opportunity (nursing in the first instance). With external funding the working group will be developing 'test and learn' simulation opportunities for across 2021-22.

Alongside this, the team are part of a VR 'test and learn' initiative (via the DSG) for clinical practice.

Lastly, within the social work and HSC arena, our project member has developed a VR simulation focussing on risk assessment and management to safeguard children in the community. This simulation was developed for health and social care practitioners and is extending this project to evaluate student learning.

4. Report on and recommend future planning of simulation with the HSC curriculum.

This can be seen in our conclusion / recommendations section of this report.

Conclusion and Recommendations

Conclusions

- Simulated education is suitable as a teaching pedagogy and teaching, learning and assessment methodology for health and social care in higher education
- Simulated education is a way in which HEI's can ensure parity of the student experience
- Simulated education has been shown to be enhance the student experience and open up learning opportunities (otherwise not available to students)
- Simulated learning, used as a scenario-based pedagogy, is effective for HSC education

- Simulated education can prepare (HSC) students before they go into practice. It is also a way in which to 'return to practice'.
- Online simulation offers an alternative to practice / placement opportunities that are

  a) hard to replicate

  b) logistically difficult

  c) protective and safe

Student outcomes

- Students report overall satisfaction with facilitated simulated learning
- Students felt prepared for practice using simulated learning
- Simulated learning allowed students were able to repeat and practice skills, review knowledge and safely 'test out' prior to and during placement learning
- Students had the opportunity to work through scenarios and learning they would not otherwise have experienced within their practice experiences
- In some studies, student achievements and outcomes were improved through repetitive practice and refining of knowledge and skills

Recommendations

- Use of simulated learning that is based **online**, unlikely to be scalable should additional costs / equipment be required (outside of expected equipment i.e. laptop, headphones, microphone).
- Skilled and knowledgeable **facilitation and debriefing** is a key aspect of simulated education.
- Need to **design in** simulated education as part of content – planned via the student journey / planner
- **Accessibility :** student needs to be enabled to make adjustments (to the simulation) ie speed of speech / visual
- **Student** (and tutor) control of the activity important for repetition, practice, revision to promote active learning.

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Appendix 1: Characteristics and extraction table (Popay et al, 2006)

Sample 3 pages of 66 pages

Characteristics and extraction table (Popay et al, 2006)

PRAXIS Project Number

Reference	Intervention	Participants	Setting/context	Outcomes	Methods/quality	Other notes
Authors, date, country	*Activity, Duration, Delivered by*	*Those involved in the intervention*	*Where/when*	*Information about effectiveness, feasibility, implementation, etc*	*Notes on conduct and quality of study*	
Aul et al 2021 **Key to Transforming a Nursing Curriculum: Integrating a Continuous Improvement Simulation Expansion Strategy** SAGE Open Nursing Volume 7: 1–7 DOI: 10.1177/237796082199852 2021 US	Intentional simulated learning (mapped, organized, and interactive) (in labs – **not online**) Online (low fidelity) patient scenarios	Nurse students N = 120	Revision of nursing curriculum	Student confidence increased (self-reported) Student feedback was positive. Students perceived the eclectic simulation experiences helped solidify learning the content while engaging them in their learning. Likert scale showed 70&, 71%, 90% & 100% satisfaction Student satisfaction aligned with their course grades. (95% competency pass but not comparative results)	no difference in educational outcomes for students who had 25% or 50% of their hours replaced with simulation.	'*The key to transforming a nursing curriculum encompasses intentional mapping, evaluation, and revision'* p1. **Codes** • Online scenario • Virtual simulation • Simulated patients • Low – high fidelity • Mapped learning
Bonito S **The usefulness of case studies in a virtual clinical environment (VCE) multimedia courseware in nursing** The Journal of Medical Investigation Vol 66 p38-41 DOI: 10.2152/jmi.66.38 2019 Philippines (OU)	Multimedia case study to replicate practice setting and practice time – without the limitations and constraints of real life Using case studies students developed a nurse plan / decision making (chronic conditions) Filmed video created using Faculty staff based on real case scenario	Post grad nurse students n=106	In classroom where theory and practice are brought together to test (replicate) real life situations (authentic)	Students reported: *realistic and relevant *links theory to practice *supports active learning *promotes critical thinking and problem solving *builds confidence	Survey following use of multimedia online case scenario. Open ended questions Purposive non-probability sampling n=53	**Codes** • Bridge theory-practice gap • Learning by doing not always possible therefore need to replicate • Filmed / acted case studies • Community of learners
McKinney, JS	Experiential learning	Social work students	TACT model as online pedagogy.	Suitable for prep for practice as well	Student qualitative	**Codes** • Prep practice

Teacher as client therapy (TACT): a model for simulated learning for traditional and online delivery models Journal of Teaching in Social Work, 39(4-5), 2019, pp.429-439. **10.1080/08841233.2019.1640339** 2019 US	responding to evolution and revolution in technology Facilitated syllabus for skills learning: active teaching techniques		Incrementally built scenarios	as assessment of this	evaluation, no descriptive statistics.	• Tele-therapy • Facilitated learning

Appendix 2 Thematic Analysis Table

Thematic Analysis Table

The project questions: (drive the global themes)

1. How might the OU develop the HSC curriculum, **to make best use of simulation, as a collaborative methodology, for teaching, learning and assessment**?
2. What might be the **impact of simulation be for the student experience and outcomes**?

With the aims (can drive the organising themes)

a) **Understand and define simulation** within the HSC curriculum through systematic literature review and understanding the student experience and outcomes.

b) Understand how **simulation fits into the teaching, learning and assessment agenda of the regulatory bodies** (associated with HSC) and HE delivery.

c) Be cognisant of **simulation curriculum and simulation development at the OU**, and how we should align HSC simulation with the OU and Faculty strategy

d) **Report on** and **recommend future planning of simulation** with the HSC curriculum. *(This will come from our review of findings)*

Global theme (from research question)	**Organising theme** (can be identified from reading and match to research aims)		**Basic themes (codes)** Derived from reading of papers / research findings (split columns as necessary)			**Narrative (analysis)** From reading, examples that illustrate findings
Types of simulation (collaborative methodology) (Bb to create this as a table)	Scenario	Technological	Video simulation (real / animated)	Tutor facilitated	Teaching / assessment	
			VR: computer generated version of reality			

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Simulated learning: teaching learning and assessment	Learning and assessment replicating f2f situation (practical)		Group learning activities online (facilitated)		AV scenario based OSCE	Preparation of learning (practical placement prep)	Reflective feedback (learning event and assessment)	
Facilitation of the simulated learning	Skilled tutor / facilitator		Professional background and education of tutor / facilitator		Investment from HEI in staff	Link simulation (IPL) to assessment		
Replacing practice learning experiences with simulation	Preparation for practice		Parity of opportunity		Scenario based (online / DVD)			
Impact for student experience	Achievement		Retention		Satisfaction / enjoyment	Value for money	Enhancing experience	
Simulation development at the OU Simulation and regulation (HE programme)	Social Work	HCP	Nursing HEE	Other	Active simulation (teaching, learning, assessment)	IPE	Replacement for practice: HEE directive to replace some practice hours with simulated learning	Safe practice opportunities	Health and nursing HEE, 2018, 2020, 2020, 2021 SW?

References / links:

National Framework for Simulation Based Education (SBE) 2018
https://www.hee.nhs.uk/sites/default/files/documents/National%20framework%20for%20simulation%20based%20education.pdf

National toolkit to support the use of simulation in health and care Faculty development guidance (HEE, 2020)
https://www.hee.nhs.uk/sites/default/files/documents/Faculty%20Development%20Guidance%20FINAL.pdf

A rapid report to identify key lessons from the initial response of the UK simulation community to the COVID-19 pandemic (HEE, 2020)
https://www.hee.nhs.uk/sites/default/files/documents/A%20rapid%20report%20to%20identify%20key%20lessons%20from%20the%20initial%20response%20of%20the%20UK%20simulation%20community%20to%20the%20COVID-19%20pandemic%20Nov%202020.pdf

A description of simulation-based techniques relevant to education and practice in health and care Technology Enhanced Learning (TEL) (HEE, 2021)
https://www.hee.nhs.uk/sites/default/files/documents/A%20description%20of%20simulation-based%20techniques%20relevant%20to%20education%20and%20practice%20in%20health%20and%20care%20Nov%202020.pdf

Definitions of simulated education:

Aul et al (2021) *The INACSL Standards Committee (2016b) defines a simulation based experience as, "A broad array of structured activities that represent actual or potential situations in education, practice, and research" (p. S45)* p1

Blakeman (2019) VR very simplistically to be a computer generated representation of a real or imaginary world. This is opposed to a view of reality that includes artificially added elements, which is known as "Augmented Reality".

Simulation is defined as, ‘‘a technique, device, or activity that aims to authentically recreate, imitate, or amplify characteristics, processes, and experiences of the real world for the purpose of teaching, acquiring and assessing knowledge, skills, and attitudes’’ (Guise, Chamberes, & Valimaki, 2012, p. 411).

“Virtual patient simulations represent a specific type of technology enhanced simulation believed to offer many of the benefits of live actor simulations, but without the logistical drawbacks commonly associated with them (Carter, Bornais, & Bilodeau, 2011; Khanna & Kendall, 2015; Triola et al., 2006; Washburn, Bordnick, & Rizzo, 2016). These simulations utilize virtual human agents (patients) to reproduce an interactive clinical encounter. Virtual patients are fully interactive avatars that can interact with students in many of the same ways that “actor” patients can” (Washburn, M., Parrish, D.E. & Bordnick, P.S., 2020, p.124)

Virtual patients - “An interactive computer simulation of real-life clinical scenarios for the purpose of health care and medical training, education or assessment” (Ellaway et al, 2008 cited in Georg and Zary, 2014, p.3)

Simulation at OU: as a narrative:

- examples of use of simulation
- examples of new initiative simulation: digital champions
- examples of student achievement (feedback)
- examples of simulation to enhance student experiences (feedback)

Recommendations

- Scenario based AV for sole education and IPE
- Use of simulation for assessment

Appendix 3: Scopus search strategy

Scopus search strategy

(TITLE-ABS-KEY ((simulation) OR (immersive) OR (interactive) OR (artificial) OR (virtual) OR ("virtual reality") OR ("simulated reality")) AND TITLE-ABS-KEY ((learn*) OR (teach*) OR (assess*) OR (student AND experience) OR (education) OR ("higher education") OR (university)) AND TITLE-ABS-KEY ((health AND care AND education) OR (social AND care AND education) OR (inter-professional AND education) OR (intra-professional AND education))) AND PUBYEAR > 1996 AND (LIMIT-TO (LANGUAGE , "English"))

Number	Search String	Results	Comment
1	(TITLE-ABS-KEY ((simulation) OR (immersive) OR (interactive) OR (artificial) OR (virtual) OR ("virtual reality") OR ("simulated reality")) AND TITLE-ABS-KEY ((learn*) OR (teach*) OR (assess*) OR (student AND experience) OR (education) OR ("higher education") OR (university)) AND TITLE-ABS-KEY ((health AND care AND education) OR (social AND care AND education) OR (inter-professional AND education) OR (intra-professional AND education))) AND PUBYEAR > 1996 AND (LIMIT-TO (LANGUAGE , "English"))	14,102	Initial search with subject librarian Fields restricted to title and abstract. Truncation and phrase searching applied Date and language filters applied
2	(TITLE-ABS-KEY ((simulation) OR (immersive) OR (interactive) OR (artificial) OR (virtual) OR ("virtual reality") OR ("simulated reality") OR ("role play") OR (patient) OR (classroom)) AND TITLE-ABS-KEY ((learn*) OR (teach*)	173, 953	Additional search terms added as discussed with team.

	OR (assess*) OR (student AND experience) OR (education) OR ("higher education") OR (university) OR (skills) OR (competencies) OR ("clinical skills") OR (experiential)) AND TITLE-ABS-KEY ((health AND care AND education) OR (social AND care AND education) OR (inter-professional AND education) OR (intra-professional AND education))) AND PUBYEAR > 1996 AND (LIMIT-TO (LANGUAGE , "English"))		("role play") OR (patient) OR (classroom) AND (skills) OR (competencies) OR ("clinical skills") OR (experiential)
3	(TITLE-ABS-KEY ((simulation) OR (immersive) OR (interactive) OR (artificial) OR (virtual) OR ("virtual reality") OR ("simulated reality") OR ("role play") OR (patient) OR (classroom)) AND TITLE-ABS-KEY ((learn*) OR (teach*) OR (assess*) OR (student AND experience) OR (education) OR ("higher education") OR (university) OR (skills) OR (competencies) OR ("clinical skills") OR (experiential)) AND TITLE-ABS-KEY (("health care education") OR ("social care education") OR ("inter-professional education") OR ("intra-professional education"))) AND PUBYEAR > 1996 AND (LIMIT-TO (LANGUAGE , "English"))	632	Phrase searching of: ("social care education") OR ("inter-professional education") OR ("intra-professional education") Limiting to date range from 2000 would omit 23. Limiting to source type of journal = 550 (conference proceeding – 37; book – 23; book series – 18; trade journal – 3; undefined – 1)
4	(TITLE-ABS-KEY ((simulation) OR (immersive) OR (interactive) OR (artificial) OR (virtual) OR ("virtual reality") OR ("simulated reality") OR ("role play") OR ("virtual patient") OR (classroom)) AND TITLE-ABS-KEY ((learn*) OR (teach*) OR (assess*) OR (student AND experience) OR (education) OR ("higher education") OR (university) OR (skills) OR (competencies) OR ("clinical skills") OR (experiential)) AND TITLE-ABS-KEY (("health care education") OR ("social care education") OR ("inter-professional education") OR ("intra-professional education"))) AND PUBYEAR > 1996 AND (LIMIT-TO (LANGUAGE , "English"))	268	(patient) amended to the phrase (“virtual patient”)

Appendix 4 Emergent Codes sept 2021

Sample page 1 of 21 columns

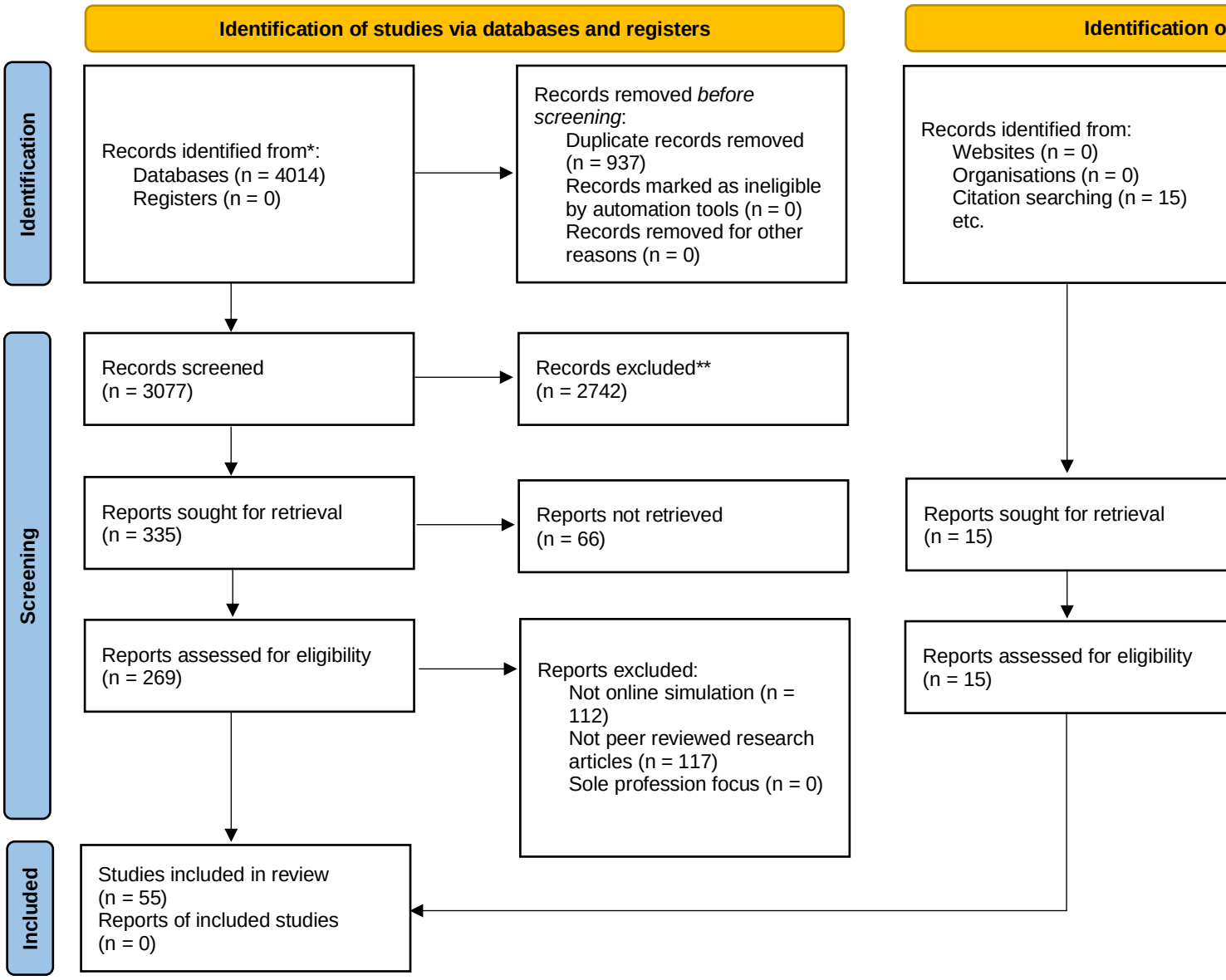
- Online
- Video
- Discussion forum
- Online ‘game’
- Hifi simulated scenario
- Synchronous audio-visual
- Simulated clients
- Active listening skills, rapport-building, empathic communication
- Clinical practice laboratories (online)
- ‘community of practice’ (amongst the students, instructors and actors)
- Online scenario
- Virtual simulation
- Simulated patients

- Low – high fidelity
- Mapped learning

- Technology = tool
- Pedagogy = all important

- Simplicity is a strength rather than a limitation:
- Bridge theory-practice gap
- Learning by doing not always possible therefore need to replicate
- Filmed / acted case studies
- Community of learners
- Communities of practice
- Practice-theory bridge
- Professional identity
- Socio-cultural learning
- Reflection
- Skilled facilitation
- Faculty investment
- Immersive and feeling of presence
- Safe practice prior to contact with service users
- Move from simulation to real knowledge
- Develops critical reflection
- Need for simulation to be *formally and substantially authentic*
- Series of simulated scenarios
- Aligned learning activities to the scenarios
- Reflection
- Faculty needs to allow workload time for simulation to be developed in the curriculum
- Blended learning approach seems promising
- Reflection
- Teach and assess competencies
- Bespoke for 'hard to reach' scenarios
- Safe space for learning
- Raise cultural awareness
- Prep for practice
- Safe spaces
- Reflective (can pause / revisit)
- 360 VR deep immersion
- Enhance digitalisation skills
- Assess proficiency (using rubrics)
- Flexible and bespoke learning
- Transferable skills
- Community of practice
- ''a technique, not a technology, to replace or amplify real experiences with guided experiences
- Increases preparation and confidence (clinical skills)
- Safe environment
- Standardized environment that enhances summative or high stakes evaluation
- Easy to use
- Content relevant to role
- Recommended future use of virtual simulation
- Enjoyable activity
- Informative
- Useful
- Intuitive

Appendix 5: Flow diagram of data base searches



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Appendix 6: Tabulation of simulation themes

Manifest-Level Themes for Each Form of Simulation Illustrating Positive and Negative Aspects

(After Tait et al, 2018)

Key: (+) denotes positive aspect (−) denotes negative aspect (o) denotes neutral aspect

Low fidelity/High fidelity

Telehealth e.g. video-conference platform	**Web based simulation scenarios** e.g. V sim for nursing; ATI real life; SPENT poverty simulation	**Computer based simulation (CBS)** e.g. SimWriter, The Neighbourhood, Virtual Interactive Case system	**Human/patient simulators** e.g. UrecathVision; radiography simulation	**Virtual reality** e.g. 3DMedSim VR-based BLS serious gaming module; MediTool (gamification); childcare virtual gaming simulation	**Hybrid simulation** (high tech mannequin & standardized patient)(video-conferencing & standardized patient)	**Virtu world** (MUV (Seco
Simulation experience						
Ease of use (-) Comfort (+) Immersive (+) Acceptability (++) Interesting (+) Personal connection (-)	Ease of use (+) Comfort (+) Enjoyable (+) Realism (--) Design (ability to multi-task) (-) Immersive (+) Acceptability (++) Anxiety (-) Safe (+)	Enjoyable (++) Realism (+++o) Design (dialogue hinders progress) (-) Active role (+) Interactive (+) Immersive (+) Acceptability (+) Anxiety (-) Interesting (+) Safe (++) Engagement (++) Challenging (-)	Ease of use (+) Realism (++) Interactive (++) Acceptability (++) Personal connection (-)	Ease of use (++) Realism (+) Design (influences retention of information) (+) Interactive (+) Immersive (+++) Interesting (+) Engagement (+) Challenging (-)	Ease of use (+) Comfort (++) Realism (+) Active role (+) Acceptability (+) Anxiety (--) Personal connection (+)	Ease Comf Enjoy Reali Desig (conv flexib Activ (++) Intera (++) Imme Accep (+) Anxie Intere Perso conne Safe Enga (+) Digit prese
Pedagogy						
Technological cost (-) Technological limits (-) Feasibility (+) Realistic scenarios (+) Debriefing (+)	 Active/self-directed learning (+) Feedback (o+) Feasibility (+)	Technological cost (--) Innovative (+) Active teaching/ guidance (+) Active/self-directed learning (++) Feedback (+) Variation in learning (++) Technological limits (-) Repeatability of resource (++) Feasibility (+-) Realistic scenarios (+) Debriefing (+)	 Active teaching/ guidance (+) Active/self-directed learning (++++++) Feedback (++) Variation in learning (+++) Technological limits (- -) Repeatability of resource (++++)	 Active/self-directed learning (++) Realistic scenarios (+)	 Innovative (+) 	Innov (++) Activ teach guida Activ direct learni Repea of res Feasi

Group learning (+) Scalability (+) Operational costs/support (-)	Presentation consistency (++) Content scope/relevance (++) Scalability (+)	Efficient learning (++) Presentation consistency (+) Reflective learning (+) Group learning (++) Contextual/ situational learning (+) Constructivist learning (+) Scalability (+) Operational costs/support e.g. faculty development, planning (-)	Efficient learning (+) Reflective learning (++) Group learning (+++) Contextual/ situational learning (+) Constructivist learning (+) Content scope/relevance (-) Flexibility (+) Scalability (+) Knowledge utilization (+)	Efficient learning (++) Constructivist learning (+) Flexibility (++) Knowledge utilization (+)	Efficient learning (+)	Refle learni Grou learni Const learni Flexi
Impact						
Satisfaction with learning (+) Knowledge (+)	Satisfaction with learning (++) Attitudes (+) Self-development (awareness & empathy) (+)	Satisfaction with learning (+++) Attitudes (+) Knowledge (+) Care competency (+) Self-development (awareness & reflection) (+)	Care competency (+) Deeper learning (+)	Satisfaction with learning (+++) Knowledge (++)	Satisfaction with learning (+) Attitudes (+) Knowledge (+) Care competency (+) Deeper learning (+)	Satisf with l (+) Attitu Deep learni Self- devel (awar

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Self-efficacy (+) Skill development (+) Reduced Student Cost (+) Digital learning (++)	Cognitive learning (+) Test scores (+)	Prepared for practice (++) Teamwork (++) Communication (-) Skill development (++) Cognitive learning (+++)	Prepared for practice (+) Teamwork (++++) Self-efficacy (++) Skill development (+++) Cognitive learning (++) Test scores (o-)	Self-efficacy (+) Skill development (+) Digital learning (+)	Prepared for practice (+) Communication (++) Self-efficacy (+) Skill development (+-) Reduced Student Cost (+) Digital learning (+)	reflec (++) Team (+++) Skill devel (++) Cogn learni (+++

Appendix 7: Tabulation of study qualities

Sample page 1 of 25 pages

Tabulation of study qualities

Reference	Intervention	Participants	Outcomes/Results	Methods/quality
Authors, date, country	*Activity, Duration, Delivered by*	*Those involved in the intervention*	*Information about effectiveness, feasibility, implementation, etc*	*Notes on conduct and quality of study*
Foronda CL, Swoboda SM, Hudson KW, Jones E, Sullivan N, Ockimey J, Jeffries PR. 2016 USA BNI record	vSim for Nursing - a web-based platform to simulate nursing scenarios. Accessed via computer laboratory – students in pairs. Students performed in scenarios with a patient who had pneumonia and developed anaphylaxis and a patient who developed cardiac arrest requiring defibrillation. 10 minute tutorial 2 hour simulation 20 minute debriefing	120 accelerated Bachelor of Science in Nursing (BSN) students participated. Fifty-four students completed the voluntary evaluations yielding a response rate of 45%. Faculty members selected the simulations.	Students were surveyed regarding their satisfaction with the experience. Most students reported that the product was easy to use (20% strongly agree, 78% agree). Nearly, all students recommended the virtual simulation for future use (98%). Several students indicated frustration with real-time features such as handwashing and the inability to multitask. Most students suggested that the virtual simulation was a positive experience. However, this innovative pedagogy warrants more stringent investigation.	A descriptive, mixed-methods design. Students were given a paper with a quick response code to scan from their smartphones that linked to an electronic survey. Data were aggregated and analyzed. Descriptive statistics were calculated, and a qualitative content analysis was performed independently by two researchers on an open ended question. Themes were derived independently and discussed until consensus was achieved. Limitations noted: Single centre only Does not identify student feedback related to working individually or remotely. No demographic data to enable generalisation. Evaluation limited to those who had brought Smartphones. Performance not related to grade award – might have influenced perceptions.

Appendix 8: Systematic Review Protocol

Administrative Information

1. Title

Outcomes of the use of online simulation within Higher Education for HWSC: protocol for a systematic review.

2. **Registration**

This protocol is not registered.

3. Authors

Corresponding author
Turner W. (WT) Associate Head of School, Curriculum/Senior Lecturer, Faculty of Wellbeing, Education & Language Studies, The Open University. w.turner@open.ac.uk
(Add address)
Other Protocol authors
Haiden S. (SH) Lecturer in Social Work, Faculty of Wellbeing, Education and Language Studies, The Open University. s.m.haider@open.ac.uk
Vseteckova J. (JV) Senior Lecturer in Health, Wellbeing and Social Care, Faculty of Wellbeing, Education and Language Studies, The Open University. jitka.vseteckova@open.ac.uk
Hallawell R. (RH) Associate Lecturer, Faculty of Wellbeing, Education and Language Studies, The Open University. r.d.hallawell@open.ac.uk
Authors' contributions
RH, WT, SH and JV conceived and drafted the protocol. All authors read and approved the final version.

4. **Amendments**

Any amendments to this protocol will be recognized in version numbering and recorded by date of change. A protocol development log will be kept to record any review team comments or suggestions not included in the working protocol.

5. **Support**

This protocol presents independent research funded by PRAXIS research scholarship funding. The views expressed in this paper are those of the authors and not necessarily those of PRAXIS or The Open University (OU).

Introduction

6. Background and rationale

As a pedagogy, simulation in higher education opens up educational opportunities to students to learn, practice and master complex practical skills. Simulation education is becoming common in higher education (HE), particularly in STEM subjects (Wu, Anderson, 2015). Simulation recreates the real-world and allows students to experience and learn from that real-world (Usherwood, HEA, 2015). From Usherwood's premise of simulation, there is a clear application for simulation to be more creatively utilised in health and social care (H&SC) education.
Simulation is a rapidly growing aspect of teaching, learning and assessment across HE. Simulation replaces real experiences with online learning opportunities that (seek to) replicate the real world, in a way that is immersive and interactive. As a teaching tool, simulation pedagogy relates to three levels:

- Learning object – a simulation which is suitable for multiple contexts to be adopted unused.
- Adaptable simulation – a simulation which need adaption to fit the context
- Bespoke simulation – created for a particular context.

Simulation learning is beginning to show that it improves confidence, competence and self-efficacy for students (Cant, Cooper, 2017) and increasingly simulation is being used as a creative way to assess technical-based health and

social care skills and competencies. Further, embedded as part of the whole curriculum (Gordon et al, 2016), simulation offers an innovative and safe multimodal educational experience for H&SC students.

Educational outcomes

Simulation is understood to help facilitate deeper learning, understanding concepts and relationships such as advanced inquiry and decision making (Gordon et al, 2016). It is a way to 'scaffold effective learning' (Chernikova et al, 2020:499) through authentic experiences; as real-life experiential learning is increasing limited. Previous literature shows that simulation positively influences student knowledge transfer, skills acquisition, enhances digital and technological skills (Pellas et al, 2016, Gordon et al, 2016). Further findings suggest that moving across simulation platforms enables students to manage learning materials efficiently through their course of study (Cant, Cooper, 2017) contributing positively to their achievements.

Policy and regulatory drivers

Simulation education is seen to deliver patient- centred, high quality educational outcomes (Health Education England (HEE), 2021). Following from the Topol Review (2017) which recommended 'NHS staff to make the most of innovative technologies such as genomics, digital medicine, artificial intelligence and robotics to improve services', HEE (2021) has set out a national strategy around equity of access to simulation education and training, which is replicated by all UK Nations health educational boards / bodies.

Experience at the Open University

Haider (OU, 2018, 2019) carried out studies on HSC education related to computer simulation for interprofessional learning (IPL) and social work. These studies, carried out with practice partners from health and social care, found that there is a need for HWSC to explore simulation within its curriculum. The benefits were found to be that simulation facilitates learning opportunities that are 'immersive' and 'related to contemporary practice', and offering learning as the 'right support, right time and place'. This knowledge should be expanded upon to help us understand how simulation, in its many forms, can be utilised within HSC curriculum to enhance teaching, learning and assessment and the student experience as a whole.

Further, simulation helps resolve practical dilemmas and mitigate ethical tensions, of experiential learning in HE. Utilising alternative experiential teaching tools in HE, has become increasingly urgent, given the HE experiences of 2020 and Covid 19.

The School of Health, Wellbeing and Social Care (HWSC) has not yet fully exploited the use of bespoke simulation within its curriculum, rather it has borrowed or adapted simulation to fit into teaching content. Simulation in higher education, as an applied pedagogy for HWSC, has the potential to offer students a chance to learn from simulated real-world situations. Initial research shows that simulation enhances academic achievements, experiences and student satisfaction.

This project seeks to identify what the different types of online simulation are, for example, virtual reality, artificial intelligence and the simulated classrooms. From this, the project will identify how simulation might be used to enhance the HWSC curriculum.

Our rationale for undertaking a mixed method review of the literature is as follows. Our review question is inclusive and exploratory in nature, designed to capture a broad range of evidence pertaining to multiple aspects of simulation within health and social care education. A mixed method review is ideally suited to our requirements, as it allows evidence drawn from diverse sources and research traditions, to be systematically synthesized in terms of its nature, features, and findings/outcomes in order to guide decision-making (Pearson et al, 2015). Thus the review is able to cover multidisciplinary topics or topics with a body of literature that includes quantitative, qualitative, and mixed methods studies and to determine not only the effects of interventions but also how/why this effect was achieved. A mixed-methods systematic review has the potential to produce a systematic review of direct relevance to practitioners in health and social care education (Pearson et al, 2015).

7. Objectives

Our research questions are:

How might the OU develop the HSC curriculum, to make best use of online simulation, as a strategy / approach for effective interactive, immersive learning, teaching and assessment?

What might be the impact of online simulation be for the student experience and outcomes?

In line with these questions, our objectives are to:

1. To understand and define online simulation within the HSC curriculum and to understand the student experience and outcomes of online simulation through a systematic literature review of quantitative and qualitative evidence.
2. To map how online simulation fits into the teaching, learning and assessment agenda of the regulatory bodies (associated with HSC) and HE delivery.
3. To inform the simulation curriculum and simulation development at the OU.
4. To report on and recommend future planning of online simulation within the HSC curriculum.

Methods

8. Eligibility criteria

We aim to review a broad range of evidence, which will include published and unpublished literature, including research articles, reports, guidelines and other grey literature relating to simulation in health and social care teaching, learning and assessment. This will provide both background and included literature for the study. Within the published research we will include primary (using quantitative, qualitative and mixed methods) evidence and secondary (e.g. review) level evidence will be used as background material. Given our time and other resource constraints, we will only include literature written in English. In order to enhance the relevance of our review findings, we will review evidence made available after 1997, to encompass the developing use of online simulation in higher education and also the development of the associated technologies. The setting for studies will be limited to higher education and encompass the experiences of educators and students.

Inclusion criteria

To be included, evidence must:

- be published in English
- be published / made available after 1997
- concern the use of online simulation in higher education for health and social care
- concern the use of online simulation for teaching, learning and assessment
- report empirical research focused on online simulation in health and social care higher education
- reports of systematic reviews of empirical research and grey literature focused on simulation in health and social care higher education will be used as background material.

Exclusion Criteria:

- Non-English publications
- Teaching methods where online simulation- based learning is not used
- Studies that do not incorporate health and social care higher education

These criteria will be applied through evaluation of the titles and abstracts of the evidence retrieved through the search strategy.

9. Information sources

Given the short timescale and consequent need to achieve a balance between sensitivity and specificity, we will focus on priority information sources. A limited number of key electronic databases, covering both published and grey literature evidence (e.g. reports, reviews, guidelines), will be searched, likely to include:
CINAHL, Social Care Online, Scopus, Web of Science, PsycINFO, BNI, Google (first 50 hits), Google Scholar (first 50 hits)

10. Search strategy

Both qualitative and quantitative studies will be sought.
All search strategies will be developed and all database searches undertaken with the support of a subject specialist librarian (based at The Open University). Using the expertise of the project review team, we will identify key journals and other potential sources of evidence and determine the databases (academic and grey literature) most likely to

yield relevant evidence. Based on this exercise, we will make final decisions regarding the databases to include in our review.
Thereafter, we will adopt a three-fold approach to searching our information sources. Firstly, in relation to the electronic databases, we will generate search terms (words and phrases, including synonyms and terminology variations). These terms will be combined using the Boolean operators 'and/or' and appropriate truncation and phrase symbols to form initial search strategies, which we will pilot against a selected database. On the basis of the insights gained in the piloting phase concerning the sensitivity and specificity of our terms, we will confirm our final search strategies to be used for each of the databases (see Appendix 1 for a sample search strategy). Secondly, the reference lists of included articles, reviews and reports etc. derived from the main database searches will be hand searched. Thirdly, we will draw on the expertise of the review team to identify other relevant evidence.

11. Study records

a) Data management
   1) Use of Mendeley reference management system to store search results.
   2) Search results will be detailed in PRISMA flow diagrams related to each database.
   3) Characteristics and extraction table used to record collected data (see Appendix 2).

b) Selection process
   1) Perform search as per search strategy
   2) Titles and abstract screened by individual reviewers and agreed with discussion by project team in line with the eligibility criteria (section 8).
   3) Full text screened for eligibility in line with search strategy and results illustrated via PRISMA flow diagrams (Moher et al, 2009)

c) Data collection process
   1) Data extracted and compiled into characteristics and extraction table (see Appendix 2) to include demographic information, methodology, intervention details, and all reported outcomes.
   2) Any disagreement about the extracted data will be resolved through discussion.

12. Data items

Information about the forms of online simulation used in health and social care higher education related to teaching, learning and assessment activity and the outcomes of their use will be extracted. Information related to the experience of both faculty and students of simulation use will also be obtained. Lastly information will be extracted relating to the use of simulation and the requirements of relevant regulatory bodies.

13. Outcomes and prioritization

The primary outcomes will be:
Identifying the forms of online simulation used in teaching, learning and assessment in HSC.
Defining the impact of online simulation use on teaching, learning and assessment in HSC.
Understanding the student experience of online simulation.

Secondary outcomes will include:
The mapping of simulation use to the requirements of regulatory bodies.
Recommendations for future planning of simulation within the HSC curriculum.

14. Risk of bias in individual studies

Only records drawn from peer reviewed journals will be included, which have thus been subject to previous review prior to publication.

15. Data synthesis

Given the broad scope of our research questions, the included evidence will be diverse in nature. Such diversity will necessitate a flexible, yet robust, approach to bringing together the body of evidence in its entirety. It is probable that this review will not be able to analyse data using meta-analysis nor pool data statistically. It is likely to include data from different study designs and capture a varied range of interventions. Results and findings will thus be detailed, organized and synthesized through a 'narrative' analysis (Ryan, 2019).

Ryan (2019, pp.3-5) outlines the major steps for a narrative synthesis as:
"1. Developing a theory of how the intervention works, why and for whom
2. Developing a preliminary synthesis of the findings of included studies
3. Exploring relationships in the data within and between studies
4. Assessing the robustness of the synthesis"

Although decisions concerning our detailed approach to synthesis can be made only when the precise nature of available evidence is known, it is possible to provide an outline at this stage. We will seek to first systematically summarise key features of included evidence (e.g. type of evidence; year of "publication"; geographical area; population) (Ryan, 2019). A study characteristics and findings table will be populated, collating data such as; reference details, details of the intervention, participants, setting and context, outcomes, methods and quality (Popay et al, 2006) – see Appendix 2.

Synthesis of findings / content of included evidence will draw on expert guidance on the conduct of thematic analysis in systematic reviews (Ryan, 2019) commonly used when evidence is derived from studies using a range of research designs and methods and where the exploration relates not only the effectiveness of interventions but also to answering a wide range of other questions, such as those about the implementation of interventions, efficacy, appropriateness and feasibility. The analysis will explore the relationship and findings both within and between the included studies, in line with the guidance from the Centre for Reviews and Dissemination (CRD, 2009). This will be carried out as part of the critical literature review using RTA frameworks and narrative review (Ryan et al, 2019).

In terms of the integration of the findings / content of included evidence, it is likely that we will first of all synthesise findings / messages according to the specific type of evidence. We will then seek to identify overarching themes according to the essential meaning of the collective body of evidence, however derived and expressed. This will be completed using Reflective Thematic Analysis (Braun and Clarke 2006; 2019) through their 6 point process of i) Familiarisation with the data ii) Coding iii) Generating initial themes iv) Reviewing themes v) Defining and naming vi) Writing up.

Whilst acknowledging the intent of Braun and Clarke (2019, p.592) to provide a fluid and flexible approach to using thematic analysis utilizing either "a constructionist or essentialist framing, an inductive and/or deductive orientation, and latent and/or semantic coding" it is like that this review will orientate toward induction (coding and theme development are directed by the content of the data), semantic coding (coding and theme development reflect the explicit content of the data), and a constructionist framing (looking at how a certain reality is created by the data). Codes and themes related to particular forms of simulation will also be tabulated utilizing a Framework method of analysis (Tait et al, 2018).
To promote rigour, drafts will be shared with the review team, who will provide feedback on fit with the original data, as well as overall sense and insight provided. This process will enable the production of an analysis, which has benefited from the input of a range of expert knowledge and understandings. This will be enabled through shared meetings and review of findings across August and September 2021.

16. Meta bias (es)

As this is intended to be a thematic systematic review that will not involve meta-analysis it is believed that appraising the quality of the individual studies to be included in the systematic review is relevant (Yu and Tse, 2013). Critical appraisal of individual primary studies will be conducted as outlined in Section 14.

17. Confidence in cumulative evidence

The Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework will be utilised to evaluate the quality of evidence and strength of recommendations that can be applied across a wide range of interventions and types of studies. Studies will be evaluated under the following GRADE domains: 1) Risk of bias 2) Imprecision 3) Inconsistency 4) Indirectness and 5) Publication bias (Guyatt et al., 2011).

Assessment of qualitative synthesis will be guided by The Confidence in the Evidence from Reviews of Qualitative Research (CERQual) (Lewin et al., 2015) approach. The four components of CERQual are: methodological limitations, relevance, coherence and adequacy of data.

Two reviewers working independently will assess the quality of the body of evidence and reach a consensus view.

List of abbreviations

HE – Higher Education

PRAXIS - scholarship and innovation centre in the Faculty of Wellbeing, Education and Language Studies at The Open University.

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Appendix 9: Protocol development log

Protocol Development Log

Date	Version	Change	Comments
27/04/2021	V2	Amendments made to Scopus search terms detailed in Appendix 1.	Following consultation with OU Subject Specialist librarian and after initial search activity.
29/06/2021	V2	EMBASE removed from search sources	Not accessible through OU systems
06/08/2021	V3	ASSIA removed from search sources	Not accessible through OU systems
06/08/2021	V3	References to simulation amended to specify online simulation	Agreed by project team that this is the focus for simulation that is required and which is also manageable within the project scope.
06/08/2021	V3	Eligibility criteria amended to include only primary research articles.	Agreed following discussion by the project team that review studies should be used as background material.
06/08/2021	V3	Reference to narrative synthesis amended to thematic analysis	Change agreed by the project team following review of the primary evidence sources.
16/08/2021	V4	Amendment made to Data synthesis section: 'We will seek to systematically summarise key features of included evidence (e.g. type of evidence; year of "publication"; geographical area; population). *This will be completed through the search and shifting of suitable literature using the 'characteristics and extraction table' (Popay et al, 2006)'.*	Change agreed with project team for clarification.
16/08/2021	V4	Amendment made to Data synthesis section: 'In terms of the integration of the findings / content of included evidence, it is likely that we will first of all synthesise findings / messages according to the specific type of evidence. We will then seek to identify overarching themes according to the essential meaning of the collective body of evidence, however derived and expressed. *This will be completed using Reflective Thematic Analysis (Braun and Clarke 2016) through their 6 point process of i) Familiarisation with the data ii) Coding iii) Generating initial themes iv) Reviewing themes v) Defining and naming vi) Writing up'.*	Clarification of approach to analysis following project team discussion.

16/08/2021	V4	Amendment made to data synthesis section: 'Synthesis of findings / content of included evidence will draw on expert guidance on the conduct of thematic analysis in systematic reviews (Ryan, *2019*) commonly used when evidence is derived from studies using a range of research designs and methods and where the exploration relates not only the effectiveness of interventions but also to answering a wide range of other questions, such as those about the implementation of interventions, efficacy, appropriateness and feasibility. The analysis will explore the relationship and findings both within and between the included studies, in line with the guidance from the Centre for Reviews and Dissemination (CRD, 2009). *This will be carried out as part of the critical literature review using RTA frameworks and narrative review (Ryan et al, 2019').*	Clarification of approach to analysis following project team discussion.
16/08/2021	V4	Reference list altered to update Ryan (2019) source.	
16/08/2021	V4	Addition to data synthesis section: 'To promote rigour, drafts will be shared with the review team, who will provide feedback on fit with the original data, as well as overall sense and insight provided. This process will enable the production of an analysis, which has benefited from the input of a range of expert knowledge and understandings. *This will be enabled through shared meetings and review of findings across August 2021'.*	Clarification of procedure and timing.
17/08/2021	V4	Amendment to data synthesis section: Given the broad scope of our research questions, the included evidence will be diverse in nature. Such diversity will necessitate a flexible, yet robust, approach to bringing together the body of evidence in its entirety. *It is probable that this review will not be able to analyse data using meta-analysis nor pool data statistically. It is likely to include data from different study designs and capture a varied range of interventions. Results and findings will thus be detailed, organized and synthesized through a 'narrative' analysis (Ryan, 2019).*	Clarification of underpinning framework for data organisation and synthesis.
17/08/2021	V4	Addition to data synthesis section: *Ryan (2019, pp.3-5) outlines the major steps for a narrative synthesis as:* *"1. Developing a theory of how the intervention works, why and for whom* *2. Developing a preliminary synthesis of the findings of included studies* *3. Exploring relationships in the data within and between studies* *4. Assessing the robustness of the synthesis"*	Text added to outline key steps in narrative synthesis/analysis.
17/08/2021	V4	Braun, V. & Clarke, V (2006) Using thematic analysis in psychology, Qualitative Research in Psychology, 3:2, 77-101, DOI: 10.1191/1478088706qp063oa Braun, V. & Clarke, V. (2019) Reflecting on reflexive thematic analysis, Qualitative Research in Sport, Exercise and Health, 11:4, 589-597, DOI:10.1080/2159676X.2019.1628806	References added for sources of thematic analysis.

17/08/2021	V4	New paragraph added to data synthesis section: *Whilst acknowledging the intent of Braun and Clarke (2019, p.592) to provide a fluid and flexible approach to using thematic analysis utilizing either "a constructionist or essentialist framing, an inductive and/or deductive orientation, and latent and/or semantic coding" it is like that this review will orientate toward induction (coding and theme development are directed by the content of the data), semantic coding (coding and theme development reflect the explicit content of the data), and a constructionist framing (looking at how a certain reality is created by the data).*	Clarification of the focus for the use of Reflexive Thematic Analysis.
27/09/2021	V5	Section 14 amended to: *Only records drawn from peer reviewed journals will be included, which have thus been subject to previous review prior to publication.*	Following project team discussion reference to the use of critical appraisal tools to judge individual studies was removed based on recognition of time and resource restrictions within the project.
27/09/2021	V5	Addition to Section 15: *Codes and themes related to particular forms of simulation will also be tabulated utilizing a Framework method of analysis (Tait et al, 2018).*	Information added to recognise data synthesis by simulation modality.

PRAXIS Project Number

Budget (please confirm final expenditure)

Resource	Description	Cost
Consultancies	**Consultant / RA** 19.5 days x £155.08 = £3,024.06 + 15% Tax & N.I. = £453.77 Total = £3,477.83	£3,477.83
Transcription costs	None	
Travel and subsistence	None	
Consumables	None	
Total	£3,477.83	

Declaration and Signatures

a) Declaration by applicant(s)

A presentation has been made at the Festival of Scholarship or alternative internal OU event.	Not yet
Comment:	
A poster has been produced for PRAXIS	Yes
Comment:	
The project has been uploaded on the Scholarship Exchange and/or ORO (this should be within 3 months of the end of the project (final project report) or within 3 months of acceptance (other publications e.g. journal papers), in line with REF Open Access Policy) Please provide link?	Not yet
Comment:	
Signature of project lead 	

Comment from PRAXIS Director	
Signature of PRAXIS Director	

Please return your completed report to:
Wels-praxis@open.ac.uk

PRAXIS Project Number