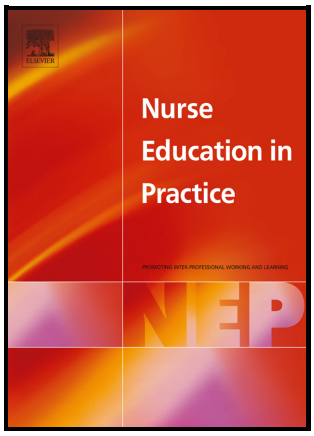
Preparing for Practice, the Effects of Repeated Immersive Simulation on The Knowledge and Self-Efficacy of Undergraduate Nursing Students: A Mixed Methods Study



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Preparing for Practice, the Effects of Repeated Immersive Simulation on The Knowledge and Self-Efficacy of Undergraduate Nursing Students: A Mixed Methods Study

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ABSTRACT

Aim

The aim of this study was to compare the effects of two immersive simulation-based education instructional designs, immersive simulation with team deliberate practice and immersive repeated standard simulation, when delivered over the same time on the knowledge and self-efficacy of nursing students.

Background

Implementing immersive simulation-based education is not without its resource challenges, making it prohibitive for simulation educators to include it in their curricula. Subsequently, there is a need to identify instructional designs that meet these challenges.

Design

A two-stage mixed methods approach was used to compare the two instructional designs.

Methods

In stage one, data was collected using questionnaires and differences estimated using analysis of covariance. In stage two, data was collected from two focus groups and analysed using a qualitative content analysis approach. Data was collected as part of a doctoral study completed in 2019 and was analysed for this study between 2022 and 2023. The justification for this study was that the identification of effective designs for immersive simulation with team deliberate practice remains a key research priority following the increase in allowable simulation hours by the Nursing and Midwifery Council.

Results

In stage one, there was no statistical significance in the participant's knowledge or self-efficacy between the models. In stage two, four themes were identified: vulnerability, development of knowledge, development of self-efficacy and preparation for placement. In contrast to stage one, participants reported that the repeated nature of both designs reinforced their knowledge base increased their self-efficacy, reduced their anxiety levels, and helped them to prepare for placement.

Conclusion

The results inferred that both designs had a positive impact on the participants. Overall, participants reported that it helped them prepare for placements. Based on the findings, wherever possible, repeated immersive simulation-based education designs should be used and not a standalone immersive simulation-based education scenarios. If resources allow, this could be either a repeat of a scenario, or if there are resource constraints to use, over the same time, immersive simulation with team deliberate practice or a similar model. Thus, giving a potential return on investment, one that supports simulation educators making those sensitive decisions regarding the inclusion of immersive simulation with team deliberate practice in their curriculum. Further research is needed into this area to ascertain the design features that maximise this impact and support a move away from standalone scenarios to an approach that utilises repetitive immersive simulation with team deliberate practice.

Registration number:

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Keywords

Simulation-based Education

Team Deliberate Practice

Repeated simulation

Repetitive simulation

Instructional design

Nursing

Knowledge

Self-Efficacy

INTRODUCTION

Due to resourcing constraints and the pressures from the increasing numbers of undergraduate students, implementing immersive simulation-based education (iSBE) (Al-Ghareeb and Cooper, 2016; Aldridge, 2016) poses significant challenges to simulation educators (Sim-Eds). Despite a growing evidence base (Moloney et al., 2022; Ragsdale and Schuessler, 2021) that indicates that iSBE better prepares healthcare students for professional practice, these challenges can make it prohibitive for Sim-Eds to include iSBE modalities into healthcare curricula (Haerling, 2018; Hippe et al., 2020). A situation faced by the authors when they endeavoured to implement iSBE into undergraduate nursing programmes.

The model implemented was an immersive repeated standard simulation (iRS-Sim) approach (Figure 1) delivered over three hours with students in small teams undertaking two scenarios. The design utilised a manikin-based modality, an approach that other studies (Carpenter et al., 2021; Moloney et al., 2022) have found effective in preparing undergraduate nursing students for practice.

The model was based on the definition of immersive simulation by the Society for Simulation in Healthcare (SSH), “a real-life situation that deeply involves the participants’ senses, emotions, thinking, and behaviour” (Lioce L. (Ed.) et al., 2020).

To provide evidence of the effectiveness of various models, Platt et al. (2021) identified there was a need to establish iSBE instructional designs that enable Sim-Eds to optimise learning while maximising their resources. If it is determined that one particular iSBE approach can accelerate participant learning over the same time period, it could provide a greater return on investment through efficient and effective use of programme time and the accelerated achievement of competence (Bukhari et al., 2017). Harris et al. (2017) highlighted Team Deliberate Practice (TDP) as a design that could improve team performance. Centred on the principles of Deliberate Practice (DP) (Ericsson, 2004), TDP combines well-defined objectives, set at an appropriate level, with opportunities for repetitive team practice, performed under the expert supervision of a coach who provides immediate feedback (Helsen et al., 1998; Lund et al., 2013). This approach has been used successfully to improve performance in various team sports (Ford et al., 2020; Machado et al., 2020). Although a number of nursing studies (Badowski and Oosterhouse, 2017; Karageorge et al., 2020) have found that iSBE incorporating DP improved team performance, there is little evidence of the

efficacy of iSBE with TDP when compared to other iSBE approaches on participants over the same time.

Platt et al. (2021) reported, at a group level, the positive effects of immersive Simulation using Team Deliberate Practice (iSim-TDP) on the performance of small teams of undergraduate nursing students when compared to the effects of immersive repeated standard simulation (iRS-Sim) over the same time (Figure 1). The original study was undertaken as part of a doctoral study completed in 2019, and was based on the key iSBE research priorities set out at the first Research Consensus Summit of the Society for Simulation in Healthcare (SSiH) (Dieckmann et al., 2011). The iSim-TDP model was developed, based on the principles of TDP, as an alternative design to enhance and optimise participants' learning within the curriculum and resourcing constraints. The study aimed to compare the effects of an iSim-TDP intervention on the observed performance of undergraduate nursing students, compared to the effects of an iRS-Sim approach, when delivered over the same time.

Since this study was published there have been increasing calls from healthcare organisations, and professional bodies, to use iSBE modalities in healthcare education, meaning that its use has grown exponentially (Aebersold, 2018; Eppich and Reedy, 2022). Globally, this has included initiatives to replace clinical placements with iSBE, including the United States of America (Bradley

et al., 2019) and China (Au et al., 2016). In the United Kingdom (UK), NHS England (2023) advocated the use of iSBE to facilitate the expansion of placement capacity, which the Nursing and Midwifery Council (NMC) (2023) endorsed and increased the number of hours that can be used for simulated practice learning (SPL) from 300 to 600 (NMC, 2023).

In light of this increase, and that the identification of effective SBE designs remained a key research priority internationally (Anton et al., 2022; Society for Simulation in Healthcare, 2023), the authors believed that it was imperative to explore the effects of the two designs further. As repeated team iSBE can improve participant's knowledge (Zulkosky et al., 2021) and confidence (Generoso et al., 2016), this paper reports on the effects, at an individual level, of the two instructional designs on the self-efficacy (confidence) and knowledge of undergraduate nursing students. An individual level was chosen, as the performance of a team is dependent on an individual's knowledge and skill (Nadler et al., 2011), and confidence is a key factor in their performance (Andreatta and Lori, 2014). It was hypothesised that when delivered over the same three-hour period, the mean self-efficacy (confidence) and knowledge scores of the iSim-TDP intervention groups would be different to the scores of the comparison groups using iRS-Sim. The data analysis for this paper took place between 2022 and 2023 as it was envisaged that exploring the initial findings further, using a mixed methods approach, would give a deeper

understanding of the effects of the two models and provide an insight into their efficacy.

METHODS

Study design

In order to gain that deeper understanding (Creswell and Creswell, 2018), the study adopted a longitudinal explanatory sequential, quantitative-qualitative, mixed methods approach (Creswell and Plano Clark, 2018). The first stage was a quantitative pre-post quasi-experimental design that compared the knowledge and self-efficacy scores of nursing students undertaking the iSim-TDP or iRS-Sim. Data was collected at three points, phases one, two and three, each three months apart, over one year (Figure 1). Following phase three, the second stage used focus groups to explore the quantitative data (Polit and Beck, 2022).

Data collection tools

The ability to underpin practice with theoretical knowledge is a key component of a nurse's overall competency (Garside and Nhemachena, 2013; Nursing and Midwifery Council, 2023). Several iSBE studies (Gates et al., 2012; Liaw et al.,

2012) have reported gains in knowledge. It enables students to translate classroom knowledge to the practice setting, and use theory to understand practice, whilst providing a safe learning environment to do so (Brown, 2019; Hope et al., 2011; Pollock and Biles, 2016), developing their knowledge through experiential learning (Kolb, 2014). To explore this, a knowledge questionnaire was developed, and designed to test the participant's knowledge of the scenario and set at the level of application (Anderson et al., 2001; Bloom, 1956). A mixture of multiple-choice questions and free-text questions were incorporated into the design. Validity was established through several stages: a University based expert panel (N=6), a second panel of advanced practitioners (N=6) followed by pilot testing (Polit and Beck, 2010). The latter, in terms of reliability, gave a Cronbach's α of 0.72, classified as good by Tolmie et al. (2011)

Andreatta and Lori (2014) identified confidence as a key factor to students' performance. One that was vital to their acquisition of clinical skills (Hecimovich and Volet, 2011). Several studies (Crowe et al., 2018; Sok et al., 2020) found that iSBE had a positive impact on a learner's confidence, and Bambini et al. (2009) postulated that iSBE promoted a student's self-confidence due to an increase in their sense of self-efficacy. Bandura (1997) defined self-efficacy as "…a person's belief in their capability to execute a course of action that was required to produce a given attainment". A strong sense of efficacy enhanced accomplishment and contributed to a learner's intellectual performance (Bandura, 1993, 1997). Thus, confidence, in terms of self-efficacy, was central

to learning (Andreatta and Lori, 2014; Perry, 2011; Roberts and Johnson, 2009). In terms of the questionnaire, seven five-point Likert scale (Göb et al., 2007) questions related to the specific SBE learning outcomes (Perry, 2011) were used to capture the self-reported self-efficacy of the participants. Validity was established through several stages: a University based expert panel (N=6) and then pilot testing (Polit and Beck, 2010), and in terms of reliability, the latter gave a Cronbach's α of 0.68, which Tolmie et al. (2011) classified as acceptable.

Data Analysis

The data from the iSim-TDP and iRS-Sim was compared using an analysis of covariance (ANCOVA) and analysed using the software package Statistical Package for the Social Sciences® (SPSS®) (IBM® SPSS® Statistics version 28). To integrate the quantitative and qualitative data, the quantitative data was used to inform the semi-structured questions of the focus groups (Creswell and Creswell, 2018; Tashakkori and Creswell, 2007). Following analysis and review of the quantitative data, three members of the research team (AP, JA, and LP-C) developed all the questions following the process outlined by Krueger and Casey (2015), which focused on the participants' feelings about taking part in an iSBE scenario. Including the development, sequencing, phrasing, revision and testing of the questions leading to questions such as "How do you feel

about participating in simulation?". One member of the team (AP) undertook the interviews, whilst a second member (JA) observed and took detailed field notes (Marshall et al., 2022). These were transcribed and analysed inductively using qualitative content analysis (Graneheim et al., 2017). Validity (or credibility) and reliability (or dependability) were maintained through the use of multiple coders (Guest et al., 2012). Two members of the research team (AP and JA) and a third independent researcher (CL) undertook the analysis outlined by Elo and Kyngas (2008) (Table 1).

Participants

The study took place in a large urban university in the UK, and the sample was recruited from a cohort of nursing students who had entered year two of a three-year undergraduate nursing programme, which led to qualification as a registered nurse in the UK. As the study took place in an existing programme, several constraints, such as timetabling, meant that the sample available (N=98) was insufficient to give an adequate power. That is the ability of a statistical test to find an effect (Field, 2018). Using the sample size calculator (https://clincalc.com/stats/SampleSize.aspx 2022) with an α of 0.05 and β (Beta) set at 0.7 gave a sample size of 98, equalling the available student population. Although quasi-experimental designs tend to have a lower power (Black, 1999), the use of randomisation enhances power (Adamson and Prion, 2013). The student groups (N=4) were, therefore, randomised into either the

iRS-Sim arm (n = 2) or the iSim-TDP arm (n = 2), and undertook their iSBE experiences in isolation of each other.

After completing the iSBE exercises, participants from both the intervention and comparison arms (N=4) were selected for qualitative focus groups using purposive sampling (Onwuegbuzie and Collins, 2007), with each group aiming to include between 4 and 12 participants.

The immersive simulation delivery and models

The time allocated in the curriculum for delivering the approaches was three hours, with one hour each for the full scenario, including the debrief. Due to the number of participants, the iSBE sessions were delivered in tandem (Figure 1); for example, in phase 1, half of the group (twelve students) would undertake the “hypovolaemia” scenario whilst the remaining twelve would undertake the “asthma” scenario. These groups were further subdivided into two groups of six, with one group observing. The groups would then be reversed, and those participants who had been observing would then undertake the second scenario. Overall, four scenarios would be delivered in the time frame, and required four staff. This process was repeated over the remaining two phases with six scenarios being used during the study.

The two designs both adopted an immersive manikin-based SBE modality. The iRS-Sim approach followed the standard three-stage SBE approach (figure 1), comprising a pre-brief, scenario and debrief (Watts et al., 2021). The participants then rotated to a different second scenario. This meant the teams undertook one scenario and one debrief before moving to the following scenario. This approach was chosen as it was the standard delivery of iSBE scenarios in the nursing programme.

As several nursing studies (Johnson et al., 2020; Li et al., 2019; Tan et al., 2022) have demonstrated, combining iSBE with DP enhanced the development of students skills. the iSim-TDP model followed a similar sequence to the iRS-Sim, but, following the principles of TDP (Helsen et al., 1998; Lund et al., 2013) after the debriefing stage, a “coached walkthrough” of the same scenario was undertaken under the guidance of an expert facilitator. Once completed, the same scenario was repeated, followed by another debrief (Figure 1). The participants then rotated to a different second scenario. This meant that the participants repeated the same scenario three times and undertook two debriefings for each, before moving to the next scenario (Platt et al., 2021). To ensure consistency, all facilitators were fully trained in using both iRS-Sim and iSim-TDP.

As recommended by The Resuscitation Council (UK) (2022), each scenario focused on the recognition of a deteriorating patient using the “ABCDE” (Airway, Breathing, Circulation, Disability and Exposure) systematic assessment

framework and, to communicate findings, the “SBAR” mnemonic (Situation, Background, Assessment and Recommendation) (The Resuscitation Council (UK), 2022). All participants, including facilitators, wore uniforms, with each scenario having a range of environmental cues. The computerised patient simulators, Laerdal’s SimMan® (Laerdal Medical, Stavanger, Norway), were programmed with salient cues that represented the signs and symptoms that would be found in a deteriorating patient. The SBE environment was set up to either represent a surgical or a medical ward.

Ethical Considerations

Institutional ethical approval was granted for the study (Reference number: RE29-06-121005) and undertaken following the principles set out in the University’s (2023) “Research Ethics and Integrity” policy. A detailed account of the study was given to the participants and underlined that their participation was on a voluntary basis, and at any time, they could withdraw from the study. Nevertheless, as the iSBE sessions were part of their nursing curriculum, they were notified that they still had to participate, but any data relating to them would not be used.

RESULTS

Stage 1 - Quantitative analysis.

In order to prevent inaccurate results, the data was assessed for potential bias and violation of assumptions (Field, 2018), none were present. The demographic data was then extracted (Table 2). During the study, one participant withdrew consent and another four left the programme, leaving 93 participants (n = 49 in the iSim-TDP arm and n = 44 in the iRS-Sim arm).

Knowledge analysis

As age was found to be a covariant, an ANCOVA was used and, following a Greenhouse-Geisser's correction, no statistically significant difference in the scores over time for each arm (Within-group) ($F_{(3.68, 151.04)} = 0.70$, $p = 0.581$, $r^2 = 0.07$, $d = 0.22$), or between the arms (Between-group) ($F_{(1, 41)} = 0.68$, $p = 0.415$, $r^2 = 0.13$, $d = 0.13$) was found (Graph 1).

Self-efficacy analysis

The ANCOVA (Graph 2), using Greenhouse-Geisser's correction, found that there was no statistically significant difference in the scores over time (Within-group) for each arm ($F_{(3.48, 149.46)} = 1.40$, $p = 0.243$, $r^2 = 0.10$, $d = 0.40$), or between the groups (Between-groups) ($F_{(1, 43)} = 0.23$, $p = 0.636$, $r^2 = 0.07$, $d = 0.08$).

Stage 2 - Qualitative analysis

Due to low attendance, only two of the four planned focus groups took place, one for the iSim-TDP arm and one from the iRS-Sim arm, with six participants in total (n=3 iSim-TDP, and n=3 iRS-Sim). As smaller group sizes, between 3 to 8 still generate rich discussions (Braun and Clarke, 2013), the data analysis was undertaken. This process generated four themes: vulnerability, development of knowledge, development of self-efficacy and preparation for placement.

Vulnerability

Participants initially felt unprepared for the iSBE experience, expressing negative emotions such as panic, apprehension, nervousness and fear of the unknown "*…it's just the anxiousness of not knowing what was behind the door*" (S2). They were concerned about feeling exposed, incompetent and making

mistakes, "*…it makes you feel incompetent…if you do something wrong…"* (S2).

Nevertheless, due to the repeated nature of both models, their anxiety decreased. They gained a better understanding of the iSBE methodology and developed coping strategies. Participants "Played it out…" (R3) before entering the scenarios, and as a group, they discussed their roles beforehand, so they didn't "go in blind, thinking…oh my…what am I going to do?" (S2). This reduced uncertainty and anxiety.

Development of Knowledge

All participants felt that iSBE reinforced their current knowledge base, "*…when I go into the scenario, I feel like actually, I know more*" (S2), and "*I think as the scenarios went on, especially the third one…you knew exactly what you knew…*" (R1). It also enabled them to explore what they did not know as it gave them "*Time to reflect… It's not until somebody briefs it back to you that you realise…the things that you've maybe missed or could have done differently*" (R2).

It increased their self-awareness around their knowledge gaps and learning needs "*By the time you get to the third scenario, which is where they are a bit more challenging, but that's…when you think I've got gaps in this*" (R1). iSBE also promoted personal growth and skill development over time.

In relation to iSim-TDP specifically, participants acknowledged the benefit of immediately repeating the same scenario, stating that "*…it was good to go back in the second time to be able to correct the mistakes…"* (S2), and "*…the second time…you knew what you were doing…you've had that debrief and you know what to kind of expect and you're not just going in at the deep end…you're more focused*" (S3).

Development of Self-Efficacy (confidence)

Several participants felt that the initial exposure to iSBE had a negative impact, with one participant (S3) commenting that the first simulation had "…*knocked her confidence*…", but continued that "*…it's made me think, well, if you want to do something to build your confidence up…you've kind of got to step up…".* This increase in self-efficacy was reflected across both arms and relied on good facilitation and debriefing. "*In one of the simulations, because we had [Facilitator name]…I knew I'd done it really badly… and we went to the debrief and…[they] gave that confidence back…"* (S2).

Repeated iSBE experiences across both the comparison and intervention arms appeared to be a factor in this. "*By the time you get to your second and third sessions… it's kind of nice to come away and know that things are slotting into place…I think that does help…in terms of confidence…"* (R1). This was also

reflected in the self-efficacy of the teams, with one participant commenting, "*…I think even looking at it as a group dynamic, confidence…as a group was a bit higher as well*" (R1). In relation to iSim-TDP, self-efficacy improved with repeated scenarios and walkthroughs, creating a safer learning environment that allowed participants to build confidence and competence. "*I think you're a…rabbit in the headlights…but not overwhelmed. I think you know that you're in a situation that it's a safe learning opportunity*" (R1).

Preparation for placement

Participants in both study arms found that iSBE allowed them to apply their prior knowledge and skills effectively. They appreciated how it complemented their lectures, seminars and practicals, providing a real-life perspective and enhancing their understanding. One participant reported, "*…we love practicals because you get involved and have a go…whereas simulation…you get to use that information, put it into perspective of why the blood pressure is so important, why the heart rate is so important, it puts it into perspective for a real person…"* (S2). This created a "link" between what students perceived as theory and practice. They recognised the realism of iSBE, enabling them to associate it with a real-life clinical situation. "*It kind of felt real…we knew it was going to be a manikin, but you just associate so much with a real-life situation*" (S2). It helped them rehearse for frequent or infrequent situations that they would see

in practice and over their careers, "*I think…you can go through your whole nursing training and not see any of these things…whereas after the simulation…I know what I could do…"* (S2). In an environment where they could practice without compromising patient safety. "*We wanted to do the things that we weren't good at because then you could practice because it wasn't in a situation where if you did it wrong that you were risking somebody's safety*" (S3). It also provided a "reality shock" that enabled them to see the relevance of iSBE to their learning journey, and their future careers, "*I think you come to realise that it's not just a fun time that you're having, it's actually at some point in your career it's going to be real life, and you've just got to step up and do it. Otherwise, you'll never get there… it's our career at the end of the day*" (R3).

DISCUSSION

This study aimed to compare the effects of two iSBE instructional designs, iSim-TDP and iRS-Sim, on the knowledge and self-efficacy of nursing students. In terms of knowledge, although there was a rise in the scores of both arms, these were not statistically significant within, or between groups. This echoes the findings of other iSBE studies (Everett-Thomas et al., 2016; Hayden et al., 2014), although contrasts markedly with the participants' descriptions, across both arms. Regardless of the design utilised, they indicated that participating in iSBE helped prepare them for placement, feeling that the approaches reinforced

their current knowledge base. The opportunity to reflect impacted positively on their learning and facilitated their personal growth.

In relation to iSim-TDP, participants acknowledged the benefit of immediately repeating the same scenario. This has been reported in other iSBE studies (Sagalowsky et al., 2018; Zulkosky et al., 2021) who identified improvements in knowledge. In this study, however, the participants in both arms reported that repeating iSBE scenarios, regardless of timeframe, developed their knowledge. Implying that the two delivery models had the same effect on their knowledge, and that the repeated iSBE exposure, rather than the specific design, had the effect.

This alludes to the benefit of repeated iSBE scenarios, either immediately after one another or when they are spaced over time. This was also reported in a systematic review by Al Gharibi and Arulappan (2020). Even though the iSim-TDP model utilised the principles of DP, the fact that the comparison group undertook repeated scenarios over a longer period may have inadvertently introduced elements of DP to these groups. As a result, this may have influenced the findings, and raises the question of what is the maximum time gap between repeated sessions before participant learning declines? An area that warrants further exploration.

The participants also acknowledged how integrating iSBE into the curriculum further supported their learning. Across both designs, they felt that iSBE enabled them to apply the knowledge and skills they had developed in lectures, seminars and practicals into their placement (Bland and Tobbell, 2016; Pollock

and Biles, 2016). As Howard (2014) asserted, possessing the relevant theoretical knowledge required for a scenario was an essential prerequisite for effective SBE. In addition, Kardong-Edgren et al. (2010) reasoned that SBE should be directed towards the synthesis and application of knowledge and designed to allow learners to apply their knowledge in a realistic setting rather than towards the development of new knowledge. The participants recognised that the realistic and immersive nature of manikin-based iSBE enabled them to associate it with a real-life clinical situation and allow them to rehearse for situations, such as emergencies, that they would see in practice. In doing so, they commented that it extended the application of their knowledge beyond the immediate scenario and helped them prepare for placement, creating a “sim-bridge” between theory and practice.

In terms of self-efficacy, again, the qualitative comments did not reflect the quantitative findings. Although several participants felt that the initial exposure to iSBE had a negative impact, they identified that the repetitive nature of the iSBE deliveries increased their self-efficacy. Further, participants in the iSim-TDP groups added that their self-efficacy was increased through the walkthrough and repeated scenarios. A finding reported by several studies using repeated SBE scenario designs (Basak et al., 2016; Cummings and Connelly, 2016; McCabe et al., 2016). This further alludes to the potential of repeated exposure to iSBE, regardless of the model, increasing self-efficacy. As self-efficacy is vital to a student’s ability to perform well (Andreatta and Lori, 2014), further research is needed to ascertain the design features that maximise impact on iSBE participants.

One noteworthy theme from the qualitative findings was that of the participants felt vulnerable, especially leading up to and during the iSBE scenarios. As Behrens et al. (2021) noted, it can evoke intense emotions in students. This negative expression towards iSBE has been well documented (Al-Ghareeb et al., 2019; Hardenberg et al., 2020). Nevertheless, the findings echoed those of Cantrell et al. (2017) who found that although students reported high-stress levels, they saw iSBE as an invaluable learning tool. The high levels of negative emotions focused on the initial scenarios, where they felt that nothing could prepare them for what was “behind the door”. This negative impact on their learning could be related to an increase in cognitive load, an effect found in other studies (Fraser et al., 2012; Schlairet et al., 2015). Reedy (2015) reported that learners can benefit from a staged iSBE approach that develops over time. An effect that was identified by participants, as repeated iSBE exposure reduced their anxiety and enabled their learning. This was echoed by Sok et al. (2020), who found that stress, anxiety and fear reduced through repeated scenarios.

iSBE also provided a safe learning opportunity (Rudolph et al., 2014), enabling them to test their capabilities, and others, in a safe learning environment (Pollock and Biles, 2016), and to “learn the sim”. The latter enabled them to develop strategies for future scenarios (Leigh, 2008) and clinical placements. As Kneebone et al. (2004) recommended, iSBE should be fully integrated into

healthcare education to provide a safe environment where learners could repeatedly practice their skills without endangering patients.

Overall, the qualitative findings provided a much deeper understanding of the experience of the participants undertaking iSBE and, how it can enhance the students' preparation for practice. A finding echoed by other authors (Davies et al., 2021; Moloney et al., 2022; Munn et al., 2021). A key finding of this study was the value that the participants placed on being able to repeat a scenario beyond the initial standalone delivery, which echoed the findings of other nursing studies (Generoso et al., 2016; Zulkosky et al., 2021). This occurred in both models, and unlike other nursing studies (Abelsson et al., 2017; Henrichs et al., 2018; Luctkar-Flude et al., 2015; Zulkosky et al., 2021) that only used a standalone model, highlights that it is the use of repeated iSBE, beyond the initial standalone scenario, that was crucial, and not the actual design of the model.

Based on these findings, when balancing the resource constraints of implementing iSBE against the benefits to the participants, wherever possible, a repeated iSBE design should be used by Sim-Eds, rather than a standalone iSBE scenario delivery. If resources allow, this could be a repeat of the same or different scenario, or if there are resource constraints, over the same time use the iSim-TDP, or similar model. As Platt et al. (2021) found, this model could

also improve participants' performance. Thus, potentially giving a good return on investment, one that supports SE's making those sensitive decisions regarding the inclusion of iSBE in their curriculum. Further research is needed into this area to ascertain the design features that maximise this impact and support a move away from standalone iSBE scenarios to an approach that utilises repetitive iSBE.

STUDY LIMITATIONS AND STRENGTHS

The study had several limitations. Firstly, the quasi-experimental element meant that there are limitations in the generalisability of the study findings, and that only associative, not causal, inferences could be made. Secondly, the study sample size was relatively small (N = 93), and a convenience sampling technique was used, further limiting the findings' generalisability. However, to reduce threats to internal validity, the groups were randomly assigned into their arms. The numbers for the qualitative component were also small (N=6), which further reduces the applicability of the findings. Finally, several logistic and technological issues, such as timetabling cancellations and loss of video captured materials, potentially effected the results.

Nevertheless, it is envisaged that the results will act as a catalyst for Sim-Eds from across the international SBE community to incorporate repeated designs into their curricula or undertaking research into this area. The study had several

strengths, the first was that it was undertaken in an actual curriculum, using participants who were undertaking the programme. This increases the potential for translation into other curricula and adds credibility to the findings. Secondly, the authors designed the data collection tools, and although a potential source of bias, the design and development of these were very specific to the study population and followed a rigorous development process. Another strength was the use of standardised methods across the arms and the use of experienced iSBE facilitators trained in using both models.

CONCLUSION

This study aimed to compare the effects of two iSBE instructional designs, iSim-TDP and iRS-Sim, on the knowledge and self-efficacy of nursing students. Although the quantitative data did not demonstrate any statistical significance the qualitative data, in contrast, inferred that both models positively impacted the participants' knowledge and self-efficacy. Overall, they reported that it helped them prepare for placement. Key to this was the repeated nature of both the iSBE models, which enabled participants to initially learn the SBE process, and then focus on their development. Based on the findings, wherever possible, repeated iSBE designs should be used and not a standalone iSBE scenarios. If resources allow, this could be either a repeat of a scenario, or if there are resource constraints to use, over the same time, iSim-TDP or a similar model.

Thus, giving a potential return on investment, one that supports Sim-Eds making those sensitive decisions regarding the inclusion of iSBE in their curriculum. Further research is needed into this area to ascertain the design features that maximise this impact and support a move away from standalone iSBE scenarios to an approach that utilises repetitive iSBE.

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CONFLICT OF INTERESTS

The authors have no conflict of interests to declare.

REFERENCES

Abelsson, A., Lindwall, L., Suserud, B.-O., Rystedt, I., 2017. Effect of Repeated Simulation on the Quality of Trauma Care. Clinical Simulation in Nursing 13, 601-608.

Adamson, K.A., Prion, S., 2013. Making Sense of Methods and Measurement: Statistical Power. Clinical Simulation in Nursing 9, e477-e478.

Aebersold, M., 2018. Simulation-Based Learning: No Longer a Novelty in Undergraduate Education. OJIN: The Online Journal of Issues in Nursing 23.

Al-Ghareeb, A., McKenna, L., Cooper, S., 2019. The influence of anxiety on student nurse performance in a simulated clinical setting: A mixed methods design. Int J Nurs Stud 98, 57-66.

Al-Ghareeb, A.Z., Cooper, S.J., 2016. Barriers and enablers to the use of high-fidelity patient simulation manikins in nurse education: an integrative review. Nurse Educ Today 36, 281-286.

Al Gharibi, K.A., Arulappan, J., 2020. Repeated Simulation Experience on Self-Confidence, Critical Thinking, and Competence of Nurses and Nursing Students-An Integrative Review. SAGE Open Nurs 6, 2377960820927377.

Aldridge, M.D., 2016. How can nurse educators perform patient simulation efficiently? Teaching and Learning in Nursing 11, 8-14.

Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., 2001. A Taxonomy for learning, teaching, and assessing: a revision of Bloom's taxonomy of educational objectives, Complete edition ed. Longman, New York.

Andreatta, P., Lori, J.R., 2014. Developing Clinical Competence and Confidence, in: Ulrich, B.T., Mancini, M.E. (Eds.), Mastering Simulation: A Handbook for Success. Sigma Teta Tau Internationa, Indianapolis, USA.

Anton, N., Calhoun, A.C., Stefanidis, D., 2022. Current Research Priorities in Healthcare Simulation: Results of a Delphi Survey. Simul Healthc 17, e1-e7.

Au, M.L., Lo, M.S., Cheong, W., Wang, S.C., Van, I.K., 2016. Nursing students' perception of high-fidelity simulation activity instead of clinical placement: A qualitative study. Nurse Educ Today 39, 16-21.

Badowski, D.M., Oosterhouse, K.J., 2017. Impact of a Simulated Clinical Day With Peer Coaching and Deliberate Practice: Promoting a Culture of Safety. Nurs Educ Perspect 38, 93-95.

Bambini, D., Washburn, J., Perkins, R., 2009 Outcomes of Clinical Simulation for Novice Nursing Students: Communication, Confidence, Clinical Judgment. Nursing Education Perspectives 30 79-82.

Bandura, A., 1993. Percieved self-efficacy in Cognitive Development and Functioning. Educational Psychologist 28, 117-148.

Bandura, A., 1997. Self-efficacy: the exercise of control. W.H. Freeman, New York.

Basak, T., Unver, V., Moss, J., Watts, P., Gaioso, V., 2016. Beginning and advanced students' perceptions of the use of low- and high-fidelity mannequins in nursing simulation. Nurse Educ Today 36, 37-43.

Behrens, C.C., Driessen, E.W., Dolmans, D.H., Gormley, G.J., 2021. 'A roller coaster of emotions': a phenomenological study on medical students lived experiences of emotions in complex simulation. Adv Simul (Lond) 6, 1-9.

Black, T.R., 1999. Doing quantitative research in the social sciences: an integrated approach to research design, measurement and statistics. SAGE, London.

Bland, A.J., Tobbell, J., 2016. Towards an understanding of the attributes of simulation that enable learning in undergraduate nurse education: A grounded theory study. Nurse Educ Today 44, 8-13.

Bloom, B.S., 1956. Taxonomy of educational objectives : the classification of educational goals. Handbook 1, Cognitive domain. London : Longman Group Ltd, London.

Bradley, C.S., Johnson, B.K., Dreifuerst, K.T., White, P., Conde, S.K., Meakim, C.H., Curry-Lourenco, K., Childress, R.M., 2019. Regulation of Simulation Use in United States Prelicensure Nursing Programs. Clinical Simulation in Nursing 33, 17-25.

Braun, V., Clarke, V., 2013. Successful qualitative research: a practical guide for beginners. Sage Publications, Los Angeles.

Brown, J.E., 2019. Graduate Nurses' Perception of the Effect of Simulation on Reducing the Theory-Practice Gap. SAGE Open Nurs 5, 1-11.

Bukhari, H., Andreatta, P., Goldiez, B., Rabelo, L., 2017. A Framework for Determining the Return on Investment of Simulation-Based Training in Health Care. Inquiry 54, 46958016687176.

Cantrell, M.L., Meyer, S.L., Mosack, V., 2017. Effects of Simulation on Nursing Student Stress: An Integrative Review. J Nurs Educ 56, 139-144.

Carpenter, C., Keegan, T., Vince, G., Brewster, L., 2021. Does simulation training in final year make new graduates feel more prepared for the realities of professional practice? BMJ Simul Technol Enhanc Learn 7, 510-516.

Creswell, J.W., Creswell, J.D., 2018. Research design: qualitative, quantitative and mixed methods approaches, 5th edition. International student edition. ed. Los Angeles : SAGE.

Creswell, J.W., Plano Clark, V.L., 2018. Designing and conducting mixed methods research, Third edition, International student edition. ed. Thousand Oaks: Sage Publications.

Crowe, S., Ewart, L., Derman, S., 2018. The impact of simulation based education on nursing confidence, knowledge and patient outcomes on general medicine units. Nurse Educ Pract 29, 70-75.

Cummings, C.L., Connelly, L.K., 2016. Can nursing students' confidence levels increase with repeated simulation activities? Nurse Educ Today 36, 419-421.

Davies, H., Sundin, D., Robinson, S., Jacob, E., 2021. Does participation in extended immersive ward-based simulation improve the preparedness of undergraduate bachelor's degree nursing students to be ready for clinical practice as a registered nurse? An integrative literature review. J Clin Nurs 30, 2897-2911.

Dieckmann, P., Phero, J.C., Issenberg, S.B., Kardong-Edgren, S., Ostergaard, D., Ringsted, C., 2011. The first Research Consensus Summit of the Society for Simulation in Healthcare: conduction and a synthesis of the results. Simul Healthc 6 Suppl, S1-9.

Elo, S., Kyngas, H., 2008. The qualitative content analysis process. J Adv Nurs 62, 107-115.

Eppich, W., Reedy, G., 2022. Advancing healthcare simulation research: innovations in theory, methodology, and method. Adv Simul (Lond) 7, 23.

Ericsson, K.A., 2004. Deliberate Practice and the Acquisition and Maintenance of Expert Performance in Medicine and Related Domains. ACADEMIC MEDICINE 79.

Everett-Thomas, R., Turnbull-Horton, V., Valdes, B., Valdes, G.R., Rosen, L.F., Birnbach, D.J., 2016. The influence of high fidelity simulation on first responders retention of CPR knowledge. Appl Nurs Res 30, 94-97.

Field, A.P., 2018. Discovering statistics using IBM SPSS statistics, 5th edition.. ed. Los Angeles : SAGE.

Ford, P.R., Hodges, N.J., Broadbent, D., O'Connor, D., Scott, D., Datson, N., Andersson, H.A., Williams, A.M., 2020. The developmental and professional activities of female international soccer players from five high-performing nations. J Sports Sci 38, 1432-1440.

Fraser, K., Ma, I., Teteris, E., Baxter, H., Wright, B., McLaughlin, K., 2012. Emotion, cognitive load and learning outcomes during simulation training. Med Educ 46, 1055-1062.

Garside, J.R., Nhemachena, J.Z., 2013. A concept analysis of competence and its transition in nursing. Nurse Educ Today 33, 541-545.

Gates, M.G., Parr, M.B., Hughen, J.E., 2012. Enhancing nursing knowledge using high-fidelity simulation. J Nurs Educ 51, 9-15.

Generoso, J.R., Jr., Latoures, R.E., Acar, Y., Miller, D.S., Ciano, M., Sandrei, R., Vieira, M., Luong, S., Hirsch, J., Fidler, R.L., 2016. Simulation Training in Early Emergency Response (STEER). J Contin Educ Nurs 47, 255-263.

Göb, R., McCollin, C., Ramalhoto, M.F., 2007. Ordinal Methodology in the Analysis of Likert Scales. Quality & Quantity 41, 601-626.

Graneheim, U.H., Lindgren, B.M., Lundman, B., 2017. Methodological challenges in qualitative content analysis: A discussion paper. Nurse Educ Today 56, 29-34.

Guest, G., MacQueen, K.M., Namey, E.E., 2012. Applied thematic analysis. Los Angeles : Sage Publications, Los Angeles.

Haerling, K.A., 2018. Cost-Utility Analysis of Virtual and Mannequin-Based Simulation. Simul Healthc 13, 33-40.

Hardenberg, J., Rana, I., Tori, K., 2020. Evaluating Impact of Repeated Exposure to High Fidelity Simulation: Skills Acquisition and Stress Levels in Postgraduate Critical Care Nursing Students. Clinical Simulation in Nursing 48, 96-102.

Harris, K.R., Eccles, D.W., Shatzer, J.H., 2017. Team deliberate practice in medicine and related domains: a consideration of the issues. Adv Health Sci Educ Theory Pract 22, 209-220.

Hayden, J.K., Smiley, R.A., Alexander, M., Kardong-Edgren, S., Jeffries, P.R., 2014. The NCSBN National Simulation Study: A Longitudinal, Randomized, Controlled Study Replacing Clinical Hours with Simulation in Prelicensure Nursing Education. Journal of Nursing Regulation 5.

Hecimovich, M., Volet, S., 2011. Development of professional confidence in health education. Health Education 111, 177-197.

Helsen, W.F., Starkes, J.L., Hodges, N.J., 1998. Team sports and the theory of deliberate practice. Journal of Sport and Exercise Psychology 20, 12-34.

Henrichs, B., Thorn, S., Thompson, J.A., 2018. Teaching Student Nurse Anesthetists to Respond to Simulated Anesthetic Emergencies. Clinical Simulation in Nursing 17, 63-71.

Hippe, D.S., Umoren, R.A., McGee, A., Bucher, S.L., Bresnahan, B.W., 2020. A targeted systematic review of cost analyses for implementation of simulation-based education in healthcare. SAGE Open Med 8, 2050312120913451.

Hope, A., Garside, J., Prescott, S., 2011. Rethinking theory and practice: Pre-registration student nurses experiences of simulation teaching and learning in the acquisition of clinical skills in preparation for practice. Nurse Education Today 31, 711–715.

Howard, V., M., 2014 Creating Effective, Evidence-Based Scenarios, in: Ulrich, B.T., Mancini, M.E. (Eds.), Mastering Simulation: A Handbook for Success Sigma Teta Tau International Indianapolis, USA, pp. 87-124.

Johnson, C.E., Kimble, L.P., Gunby, S.S., Davis, A.H., 2020. Using Deliberate Practice and Simulation for Psychomotor Skill Competency Acquisition and Retention: A Mixed-Methods Study. Nurse Educ 45, 150-154.

Karageorge, N., Muckler, V.C., Toper, M., Hueckel, R., 2020. Using Simulation With Deliberate Practice to Improve Pediatric ICU Nurses' Knowledge, Clinical Teamwork, and Confidence. J Pediatr Nurs 54, 58-62.

Kardong-Edgren, S., Adamson, K.A., Fitzgerald, C., 2010. A Review of Currently Published Evaluation Instruments for Human Patient Simulation. Clinical Simulation in Nursing 6, e25-e35.

Kneebone, R.L., Scott, W., Darzi, A., Horrocks, M., 2004. Simulation and clinical practice: strengthening the relationship. Med Educ 38, 1095-1102.

Kolb, D.A., 2014. Experiential learning: experience as the source of learning and development, Second edition. ed. Upper Saddle River, New Jersey: Pearson Education Inc.

Krueger, R.A., Casey, M.A., 2015. Focus groups: a practical guide for applied research, 5th edition. ed. Thousand Oaks, California: SAGE.

Leigh, G.T., 2008. High-Fidelity Patient Simulation and Nursing Students' Self-Efficacy: A Review of the Literature. International Journal of Nursing Education Scholarship 5, 1-17.

Li, J., Li, X., Gu, L., Zhang, R., Zhao, R., Cai, Q., Lu, Y., Wang, H., Meng, Q., Wei, H., 2019. Effects of Simulation-Based Deliberate Practice on Nursing Students' Communication, Empathy, and Self-Efficacy. J Nurs Educ 58, 681-689.

Liaw, S.Y., Scherpbier, A., Rethans, J.J., Klainin-Yobas, P., 2012. Assessment for simulation learning outcomes: a comparison of knowledge and self-reported confidence with observed clinical performance. Nurse Educ Today 32, e35-39.

Lioce L. (Ed.), Lopreiato J. (Founding Ed.), Downing D., Chang T.P., Robertson J.M., Anderson M., Diaz D.A., Eds.), S.A.E.A., Group, t.T.a.C.W., 2020.

Healthcare Simulation Dictionary - Second Edition, Second Edition ed. Agency for Healthcare Research and Quality, Rockville, MD.

Luctkar-Flude, M., Tyerman, J., Wilson-Keates, B., Pulling, C., Larocque, M., Yorke, J., 2015. Introduction of unresponsive patient simulation scenarios into an undergraduate nursing health assessment course. J Nurs Educ 54, 281-285.

Lund, O., Musaeus, P., Christensen, M.K., 2013. Shared Deliberate Practice: A Case Study of Elite Handball Team Training. Athletic Insight 5.

Machado, G., González-Víllora, S., Sarmento, H., Teoldo, I., 2020. Development of Tactical Decision-making Skills in Youth Soccer Players: Macro- and Microstructure of Soccer Developmental Activities as a Discriminant of Different Skill Levels. International Journal of Performance Analysis in Sport 20, 1072-1091.

Marshall, C., Rossman, G.B., Blanco, G.L., 2022. Designing qualitative research, Seventh edition. ed. Thousand Oaks, California: SAGE Publishing, Inc.

McCabe, D.E., Gilmartin, M.J., Goldsamt, L.A., 2016. Student self-confidence with clinical nursing competencies in a high-dose simulation clinical teaching model. Journal of Nursing Education and Practice 6, 52 - 58.

Moloney, M., Murphy, L., Kingston, L., Markey, K., Hennessy, T., Meskell, P., Atkinson, S., Doody, O., 2022. Final year undergraduate nursing and midwifery students' perspectives on simulation-based education: a cross-sectional study. BMC Nurs 21, 299.

Munn, A.C., Lay, B., Phillips, T.A., George, T.P., 2021. Assessing the Impact of Unfolding Case Study Scenarios during High-Fidelity Pediatric Simulation among Undergraduate Nursing Students. Healthcare (Basel) 9.

Nadler, I., Sanderson, P.M., Liley, H.G., 2011. The accuracy of clinical assessments as a measure for teamwork effectiveness. Simul Healthc 6, 260-268.

NHS England, 2023. NHS Long Term Workforce Plan. NHS England.

Nursing and Midwifery Council, 2023. Standards for Education and Training. Part 3: Standards for Pre-registration Nursing Programmes. Nursing and Midwifery Council, London.

Onwuegbuzie, A.J., Collins, K.M.T., 2007. A typology of mixed methods sampling designs in social science research. Qualitative report 12, 281-316.

Perry, P., 2011. Concept Analysis: Confidence/Self-confidence. Nursing Forum 46, 218-230.

Platt, A., McMeekin, P., Prescott-Clements, L., 2021. Effects of the Simulation Using Team Deliberate Practice (Sim-TDP) model on the performance of undergraduate nursing students. BMJ Simul Technol Enhanc Learn 7, 66-74.

Polit, D.F., Beck, C.T., 2010. Essentials of nursing research: appraising evidence for nursing practice, 7th ed. ed. Wolters Kluwer Health/Lippincott Williams & Wilkins, Philadelphia, Pa.

Polit, D.F., Beck, C.T., 2022. Essentials of nursing research : appraising evidence for nursing practice, Tenth edition..

International edition.. ed. Philadelphia : Wolters Kluwer.

Pollock, C., Biles, J., 2016. Discovering the Lived Experience of Students Learning in Immersive Simulation. Clinical Simulation in Nursing 12, 313-319.

Ragsdale, M., Schuessler, J.B., 2021. An integrative review of simulation, senior practicum and readiness for practice. Nurse Educ Pract 55, 103087.

Roberts, D., Johnson, M., 2009. Newly qualified nurses: competence or confidence? Nurse Educ Today 29, 467-468.

Rudolph, J.W., Raemer, D.B., Simon, R., 2014. Establishing a safe container for learning in simulation: the role of the presimulation briefing. Simul Healthc 9, 339-349.

Sagalowsky, S.T., Prentiss, K.A., Vinci, R.J., 2018. Repetitive simulation is an effective instructional design within a pediatric resident simulation curriculum. BMJ Simul Technol Enhanc Learn 4, 179-183.

Schlairet, M.C., Schlairet, T.J., Sauls, D.H., Bellflowers, L., 2015. Cognitive load, emotion, and performance in high-fidelity simulation among beginning nursing students: a pilot study. J Nurs Educ 54, S5-11.

Society for Simulation in Healthcare, 2023. 2023 SSH Research Summit. Society for Simulation in Healthcare.

Sok, S.R., Kim, J.A., Lee, Y., Cho, Y., 2020. Effects of a Simulation-Based CPR Training Program on Knowledge, Performance, and Stress in Clinical Nurses. J Contin Educ Nurs 51, 225-232.

Tan, K.Z.Y., Seah, B., Wong, L.F., Lee, C.C.S., Goh, H.S., Liaw, S.Y., 2022. Simulation-Based Mastery Learning to Facilitate Transition to Nursing Practice. Nurse Educ.

Tashakkori, A., Creswell, J.W., 2007. Editorial: The New Era of Mixed Methods. Journal of Mixed Methods Research 1, 3-7.

The Resuscitation Council (UK), 2022. The ABCDE Approach. Resuscitation Council (UK), pp. https://www.resus.org.uk/library/abcde-approach.

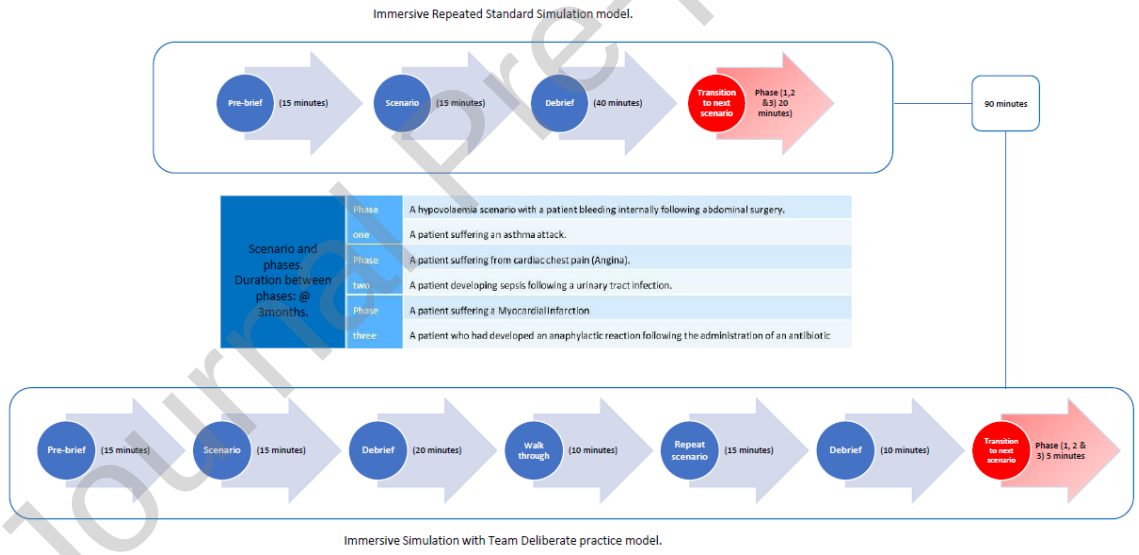
Tolmie, A., Muijs, D., McAteer, E., 2011. Quantitative Methods in Educational and Social Research Using SPSS. Open University Press, Maidenhead.

University, 2023. University's research ethics and integrity.

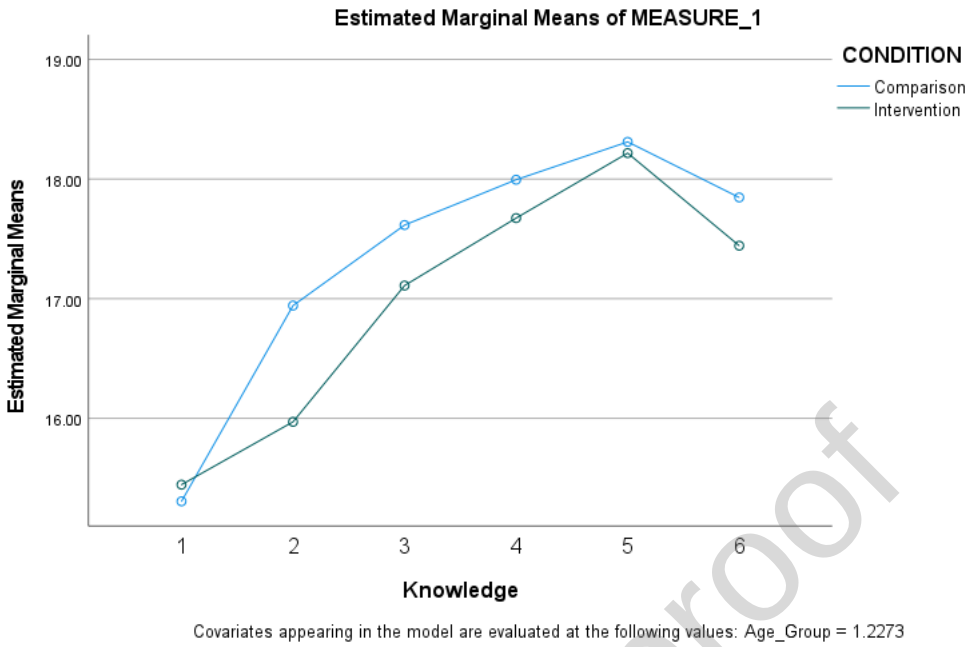
Watts, P.I., McDermott, D.S., Alinier, G., Charnetski, M., Ludlow, J., Horsley, E., Meakim, C., Nawathe, P.A., 2021. Healthcare Simulation Standards of Best PracticeTM Simulation Design. Clinical Simulation in Nursing 58, 14-21.

Zulkosky, K., Minchhoff, D., Dommel, L., Price, A., Handzlik, B.M., 2021. Effect of Repeating Simulation Scenarios on Student Knowledge, Performance, Satisfaction and Self-Confidence. Clinical Simulation in Nursing 55, 27-36.

Figure 1 – the immersive simulation-based education models and delivery



Graph 1: Knowledge ANCOVA scores



Graph 2: Self-efficacy ANCOVA scores

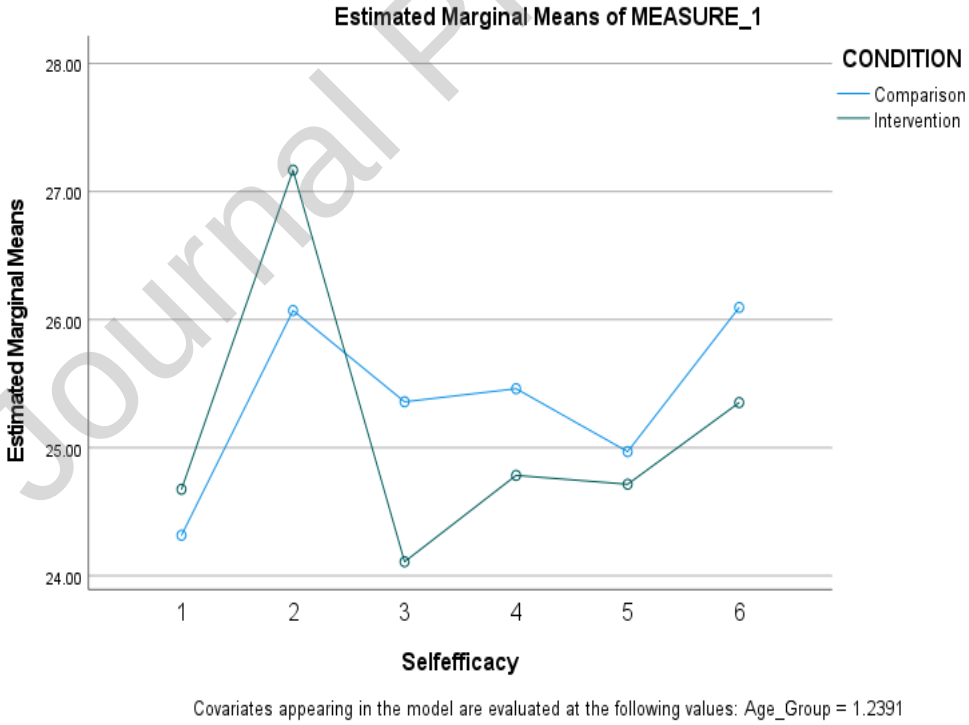


Table 1: Qualitative content analysis table

Table 2: Qualitative content analysis (Elo and Kyngas, 2008)	
Preparation phase	a. Selecting the unit of analysis and reading the material repeatedly
Data organisation phase	a. Open coding and coding sheets
	b. Grouping
	c. Categorization
	d. Abstraction
Reporting phase	a. Reporting the analysing process and results

Table 2

Demographic Data

			Intervention	Comparison	*t* - Test	*p* - value	χ2	*p* - value
Participants		98	52 (53%)	46 (57%)	1.04	0.303	3.93	0.686
	Withdrew	1	1	0				
	Left programme	4	2	2				
	Grand total	93	49	44				
Gender	Male	3 (3%)	2	1	-.492	0.624	.246	0.620
	Female	95 (97%)	50	45				
Age	18-24	73 (76%)	34	39	2.090	0.039	4.26	0.039
	25-30	24 (24%)	17	7				

31-36	6 (6%)	5	1
37 +	8 (8%)	4	4

Author contributions:

Conceptualisation, methodology: Alan Platt, Linda Prescott-Clements and Peter McMeekin. Data analysis: Alan Platt, Peter McMeekin, Jaden Allan and Claire Leader. Data curation, Writing, original draft preparation: Alan Platt, Jaden Allan and Claire Leader. Data Collection: Alan Platt and Jaden Allan. Supervision: Peter McMeekin and Linda Prescott-Clements. Reviewing and editing: Alan Platt, Jaden Allan, Claire Leader, Peter McMeekin, and Linda Prescott-Clements.

Conflict of interests:

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Registration number:

YNEPR-D-23-00947

Highlights:

- The study implies that the model "Immersive Simulation using Team Deliberate Practice" was a viable approach to use within undergraduate nursing education.
- Our study also suggests that repeated immersive simulation, regardless of the model adopted, can improve the knowledge and self-efficacy of individual learners.
- The study infers that the participants recognised and valued the benefits of repeated simulation exposure, regardless of the model, over a single standalone delivery.