



Review

Healthcare students' perceptions and experiences of making errors in simulation: An integrative review

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A B S T R A C T

Background: Research literature suggests that learning from mistakes facilitates new insights and leads to professional development. The significant growth in the use of simulation-based learning is premised on the understanding that in this context learners can make and learn from their errors without negatively impacting real patients. However, studies also suggest that making errors can be emotionally detrimental to learners. Given these contradictory findings, this literature review explores learners' views about this phenomenon.

Objective: The objective of this integrated review was to explore healthcare students' perceptions of making errors during simulation-based learning experiences.

Design: Whittemore and Knaff's framework for integrated reviews was used to structure this review.

Data sources: Five electronic databases MEDLINE, CINAHL, PsycINFO, ProQuest, and SCOPUS and the search engine Google Scholar were searched. The initial terms used were nursing students, medical students, health professionals, error*, mistake*, and simulation.

Methods: The original search resulted in 2317 potential records. After screening against the inclusion/exclusion criteria, 11 articles were critically appraised using The Critical Appraisal Skills Program (CASP) checklist and were included in the review.

Results: The two overarching themes to emerge from the analysis were *the impact of errors on learners* and *the impact of errors on learning*.

Conclusion: Despite the negative feelings experienced by some students regarding making mistakes in simulation, there were key factors that moderated the impact of these feelings and transformed the errors into learning opportunities. These included: the provision of a safe learning environment where constructive feedback was provided by skilled educators, and where students were supported to take responsibility for their mistakes. Although the findings suggest that making mistakes in simulation-based learning can be beneficial, optimising learning from mistakes requires a deliberate and thoughtful approach in which educators plan for and support learners to recognise, acknowledge and respond effectively to errors.

1. Introduction

Healthcare errors represent a major source of morbidity and mortality globally. It is estimated that internationally patients experience approximately 16.8 million adverse events each year (Jha et al., 2013), making healthcare errors the third leading cause of death in developed countries (Makary and Daniel, 2016). In recognition of the need to address these concerning patient safety statistics, simulation based-learning (SBL) has emerged as an almost ubiquitous educational approach for healthcare students and practising clinicians.

SBL is defined as an educational method designed to replace or replicate real experiences with authentic learning opportunities in a fully interactive manner (Gaba, 2004). The key premise of healthcare SBL is that it is a way for healthcare students and clinicians to develop knowledge and skills, whilst protecting patients from unnecessary risks (Lateef, 2010). With reference to this ethical mandate, the literature also asserts that SBL is an opportunity to make and learn from mistakes without compromising the care of 'real' patients

(Gardner et al., 2015; King et al., 2013; Ziv et al., 2005).

However, this assertion may be rhetorical as students do not always feel 'safe' making errors in SBL, and sometimes express concerns that failure can be prejudicial for them (Ganley and Linnard-Palmer, 2012). In some situations, this has led to students adopting defensive attitudes, such as denigrating the SBL activity or denying that the error was committed (Ziv et al., 2005). Given these contradictory findings, and in recognition of the potentially positive and negative impact of errors on students and their learning, this integrative literature review sought to explore healthcare students' perceptions of making errors during SBL experiences.

2. Background

The term *error* has been defined in a variety of ways across various disciplines. In educational psychology, error refers to 'incorrect responses to a task or situation' (Clifford, 1979, p. 44). Error and *failure* constructs have a similar conceptual meaning. Kapur (2014) defined

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failure as individuals' inability to generate correct solutions or address problem-solving tasks. In SBL, with the exception of Bearman et al. (2018, p. 8), who refer to failure as 'things going wrong', several authors commonly use the constructs error and failure interchangeably (Bould et al., 2012; Helyar et al., 2013; Kneebone et al., 2004; Young et al., 2016).

In the same vein, the concepts of *error* and *mistake* in SBL are undifferentiated (Gaba, 2000; Helyar et al., 2013; INACSL, 2016; Young et al., 2016). However, Reason (1990) argued that these constructs are ontologically different. *Error* is an action that fails to achieve a desired outcome, whereas a *mistake* occurs when the plan to achieve a goal is inadequate (Reason, 1990). Based on these definitions, the subtle distinction between these terms becomes evident and may explain, in part, the reasons why they are often inextricably intertwined. For the purpose of this review, these constructs will be used interchangeably as the concept of mistake by far is the most used in SBL literature.

2.1. Contextualising the use of errors in SBL

It is argued that the introduction of *desirable difficulties* during learning activities facilitates learning (Bjork and Bjork, 2011; Bjork, 1994). Desirable difficulties are, for instance, those that seem to slow the learning process and elicit errors (Kevin, 2009). Examples of desirable difficulties include complex problem-solving tasks, and unguided learning activities (Kapur, 2016). Research literature suggests that by addressing desirable difficulties, students are more likely to develop durable and flexible learning (Bjork and Bjork, 2011; Bjork, 1994). On the contrary, when students do not address desirable difficulties while solving learning tasks they tend to believe that subject-content was fully understood; however, this knowledge may not be retained and applied in future learning situations (Bjork, 1994; Kevin, 2009).

In the context of SBL, an example of a desirable difficulty is when students engage in a complex SBL scenario where multiple unpredictable clinical issues unfold. However, during many SBL activities, learners are instructed to follow sequential steps to avoid making errors (King et al., 2013). There is the notion that errors are detrimental for learners and should be prevented at all cost. In some occasions, facilitators 'rescue' students when they make an error by stopping the scenario or providing hints to change the direction of the activity (Brown, 2011). Satava (2007) argued that instead of only instructing medical trainees to develop skills correctly in simulation, they should also learn the meaning of errors and how to address them effectively.

A recent study on ultrasound simulation training suggested that the use of error management strategies, such as framing errors positively and instructing students to make errors during a SBL activity, allowed students to transfer what they learned from the simulation to clinical settings, compared with those who were instructed not to make errors (Dyre et al., 2017). Although there are several issues associated with the use of error management training in SBL (Heitzmann et al., 2017), one aspect that needs more understanding is students' views and experiences of making mistakes in SBL, and how these mistakes impact their personal responses and professional development. Consequently, this integrative literature review sought to explore healthcare students' perceptions of making errors during SBL experiences.

3. The review

3.1. Design

Whittemore and Knaf's (2005) framework was used to guide the integrative review as it provides a rigorous, comprehensive and methodological approach.

Table 1

Literature searching conducted in MEDLINE.

1. Nursing students.mp. or Students, Nursing/
2. Medical students.mp. or Students, Medical/
3. Health professionals.mp. or Health Personnel/
4. (error* or mistake*).mp. [mp = title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
5. SIMULATION TRAINING/ or simulation.mp.
6. 1 or 2 or 3
7. 4 and 5 and 6
8. limit 7 to (English language and yr = "2000–2018")

3.2. Aim

The aim of this review was to explore healthcare students' perceptions of making errors during SBL experiences.

3.3. Search methods

The MEDLINE database was consulted to become familiar with terms related to the topic of interest. The initial search terms were nursing students, medical students, health professionals, error*, mistake*, and simulation (see Table 1). Subsequently, a more narrowed searching was carried out using the following electronic databases CINAHL, PsycINFO, ProQuest and SCOPUS and the search engine Google Scholar. Finally, additional articles were manually identified through review of the reference lists of included articles.

3.4. Search limits

The literature search was limited to records published in English from 2000 to 2018. This period was included due to the exponential increase in the use of simulation in healthcare education during the last two decades (Motola et al., 2013).

3.5. Inclusion criteria

This review considered primary data sources that documented students' perceptions of making mistakes during the simulation activity. Articles that reported students' perceptions of making mistakes in the findings reported were included in the review.

3.6. Exclusion criteria

Unpublished and non-English records were excluded from the review.

3.7. Search outcomes

The original search resulted in 2317 potential records. EndNote® software was used to manage the records and eliminate duplicate papers. Four records were added through hand searching from the reference list of the included articles. Titles and abstracts were then examined, resulting in the exclusion of 2249 records. Reasons for exclusions mainly were articles did not describe students' perceptions of making mistakes and did not include making mistakes in the findings reported. The 72 remaining records were screened against the inclusion/exclusion criteria by the first author (EP) and discussed with the other authors (TP and TL-J), to reach consensus. This left 11 articles for critical appraisal and inclusion in this literature review. Fig. 1 illustrates the selection process.

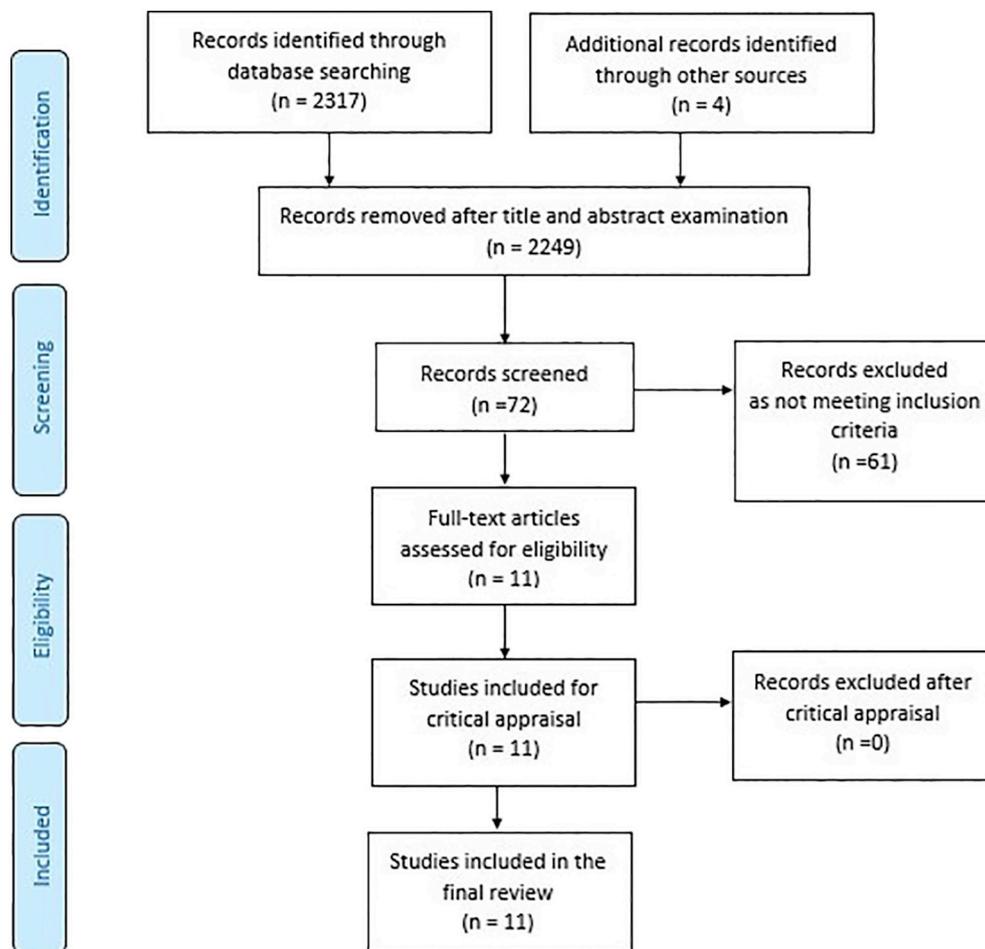


Fig. 1. Flow diagram of study selection process. Adapted from Moher et al. (2009).

3.8. Data analysis

The data analysis process began by tabulating the features of each study (see Table 2). The features for the tabulation were taken from (van der Riet et al., 2018) and included citation, location, quality, aim, design, sample, analysis, results, and limitations. Open coding was initially used to identify emergent codes (Draucker et al., 2007). Then, using NVivo® software, codes were allocated to data ‘chunks’ (categories) to identify recurring patterns (Miles et al., 2014), and subsequently condensed into overarching themes.

3.9. Data evaluation

The included studies were appraised using the Critical Appraisal Skills Program (CASP) checklist (Critical Appraisal Skills Program, 2017). The items included in this checklist include aim, methodology, research design, recruitment strategy, data collection, the relationship between the researcher and the participants, ethical issues, data analysis, findings, and overall value. Each item scores one point with an overall score of 10.

4. Results

4.1. Quality of included studies

The results of the critical appraisal undertaken using CASP (Critical Appraisal Skills Program, 2017) checklist indicated the majority of studies scored 8–10 for most criteria. However, some studies had limitations. For instance, apart from Reime et al.’s (2016) interprofessional study, each of the studies included only a single group of participants.

Additionally, only one study measured the potential long-term impact of making mistakes in SBL.

4.2. Characteristics of included studies

The included studies originated from seven countries: the United States of America ($n = 4$), Sweden ($n = 1$), United Kingdom ($n = 2$), New Zealand ($n = 1$), South Korea ($n = 1$), United Arab Emirates ($n = 1$) and Norway ($n = 1$).

4.3. Characteristics of participants

Four studies included nursing students (Bussard, 2015; Harder, 2012; Helyar et al., 2013; Song and Jeong, 2015), three included medical students (Bond et al., 2004; Botezatu et al., 2010; Young et al., 2016), one included midwifery students (Hughes et al., 2014), and another study involved medical imaging students (Elshami and Abuzaid, 2017). One study (Reime et al., 2016) was interprofessional and included both nursing and medical students. The participant sample size for the 11 included studies ranged from 9 to 262 (mean $n = 102$). The overall number of participants was 609.

4.4. Study designs

Seven of the studies were qualitative (Bond et al., 2004; Botezatu et al., 2010; Bussard, 2015; Harder, 2012; Helyar et al., 2013; Song and Jeong, 2015; Young et al., 2016), and four used a mixed methods approach (Elshami and Abuzaid, 2017; Hughes et al., 2014; Reime et al., 2016; Sullivan et al., 2016).

Table 2
Included studies.

Citation/location/quality	Aim/purpose	Design	Sample	Analysis	Results	Limitations
Young et al. (2016) NZ Quality rating: 10/10 (CASP)	To identify core components of students' SBL experiences.	Qualitative, phenomenology	Medical students (n = 77)	Thematic analysis	Participants perceived mistakes as learning opportunities. Feedback was crucial to learn from mistakes.	
Bussard (2015) USA Quality rating: 10/10 (CASP)	To examine students' experiences of simulated encounters to develop accountability skills.	Qualitative	Nursing students (n = 15)	Thematic analysis	Students learnt from their mistakes. Taking responsibility for own errors was crucial for learners.	
Song and Jeong (2015) South Korea Quality rating: 9/10 (CASP)	To explore the experiences of nursing students in a clinical simulation encounter.	Qualitative, phenomenology	Nursing students (n = 9)	Thematic analysis	Students understood the importance of taking responsibility for their mistakes.	Ethical aspects were not addressed
Harder (2012) USA Quality rating: 10/10 (CASP)	To explore values and beliefs about HPSMs.	Qualitative, ethnography	Nursing students (n = 11), Instructors (n = 20)	Thematic analysis	Even though some students reported emotional distress making mistakes, they valued committing errors in simulation and not with real patients.	
Bond et al. (2004) USA Quality rating: 9/10 (CASP)	To explore emergency medicine residents' perceptions using challenging simulation scenarios.	Qualitative, in-depth interviews	Emergency medicine residents (n = 15)	Thematic analysis	Making mistakes caused reflection/motivation. The simulation was stressful, but it was not possible to establish that errors were the cause of stress.	Content validity was not addressed
Botzatzu et al. (2010) Sweden Quality rating: 10/10 (CASP)	To examine medical students' opinions on the use of virtual patients.	Qualitative, exploratory	Undergraduate Medical students (n = 16)	Thematic analysis	Students' comments highlighted that once an error is committed it is less likely to commit the same mistake in a clinical setting.	Students were randomly selected
Helyar et al. (2013) UK Quality rating: 10/10 (CASP)	To determine if a low-fidelity simulation provides a realistic learning experience for pre-registration nursing students.	Qualitative, in-depth interviews	Pre-registration nursing students (n = 12)	Thematic analysis	Making errors should be an active component in simulation experiences.	
Elshami and Abuzaid (2017) United Arab Emirates Quality rating: 8/10 (CASP)	To examine students' perceptions of a Magnetic Resonance Imaging simulation training.	Mixed methods	Medical imaging students (n = 29)	Content analysis, descriptive statistics	60% of participants recognised that they learnt from their mistakes.	
Sullivan et al. (2016) USA Quality rating: 7/10 (CASP)	To investigate students and faculty engagement using simulated patient scenarios.	Mixed methods	Medical students (n = 98)	Content analysis, descriptive statistics	Students valued addressing the clinical cases by themselves and seeing the consequences of their decisions. Participants did not feel embarrassed making mistakes in a safe environment, even though they lost points for their mistakes	Ethical issues were not addressed
Reime et al. (2016) Norway Quality rating: 8/10 (CASP)	To explore students' experience of an interprofessional simulation activity and its impact on patient safety.	Mixed methods	Bachelor, postgraduate nursing students, and medical students (n = 262)	Content Analysis, descriptive statistics	Making mistakes seems to improve the quality of patient care, as students become more alert in clinical settings	Relationship between researcher and participants was not specified
Hughes et al. (2014) UK Quality rating: 8/10 (CASP)	To examine the midwifery students' perceptions of self-efficacy after a simulated maternal obstetric emergency.	Mixed methods	Midwifery students (n = 65)	Content Analysis, descriptive statistics	Participants learnt from their mistakes. The support and constructive feedback provided by instructors was crucial.	

4.5. Study findings

It should be noted that only one of the included studies was conducted specifically with a focus on mistakes in simulation. Instead, the analysis of students' views about their experiences typically included reference to the impact of and learning from the errors they had made. Indeed, this was a key finding in each of the eleven studies included in the review. Thus, the two overarching themes to emerge from the analysis were the **impact of errors on learners** and the **impact of errors on learning**.

4.5.1. The impact of errors on learners

4.5.1.1. Negative feelings - frustration, guilt and fear. While students' perceptions of making mistakes during SBL were often positive, intense feelings of frustration were described in several studies. For example, in Helyar et al.'s (2013) study, almost all participants reported the detrimental emotional effects of making mistakes with reference to negative feelings such as frustration, guilt and fear. However, the participants still regarded making mistakes during the SBL activity to be critical for their learning. Harder (2012) and Young et al. (2016) referred to how, in the debriefing that followed the simulation, both nursing and medical students expressed frustration at the mistakes they had made. However, students typically recognised the benefits of making mistakes, and to some extent, this helped to offset some of the associated distress.

'I was frustrated with myself for not being more complete in my examination and for missing a "red flag" but I learnt from this case the importance of being thorough when doing examinations'.
(Young et al., 2016, p. 70)

'I remember being a bit peeved that I made an error, and I then when I looked back on it, it was like the whole point... it really made you aware of how important it is not to make errors'.
(Helyar et al., 2013, p. 14)

4.5.1.2. The comfort of knowing that mistakes made during SBL do not present a risk for 'real' patients. Despite the negative feelings experienced by some students in response to the errors they made during SBL, there were key factors that lessened the impact of these feelings and transformed the mistakes into learning opportunities. One factor included a SBL experience where students could focus on learning without the concern of 'real' patients being harmed.

SBL experiences are designed to replicate the real world of clinical practice in an immersive and authentic manner (Gaba, 2004), and several studies included in this review described how students felt safe in and valued SBL experiences because the care of 'real' patients was not compromised. For example, in Hughes et al.'s (2014) study, where midwifery students ($n = 65$) were exposed to a simulated maternal obstetric emergency, participants attributed their enhanced learning and self-efficacy to the comfort of knowing that the mistakes they made during the simulation activity did not present a risk for 'real' women or babies. In another study examining medical students' ($n = 16$) views about virtual patients, Botezatu et al. (2010) found that students reported feeling less 'stressed' making mistakes with simulated patients because the consequences were not as severe as in clinical practice. Similarly, in a study exploring nursing students' ($n = 11$) perceptions of high-fidelity manikin-based simulations, Harder (2012) noted that, although some students reported emotional distress from making mistakes, they nevertheless valued the opportunity to do so during a SBL activity rather than in a clinical setting with 'real' patients.

'And that would be the time to make a mistake, not with the patient. So that part is good that you can do a mock stuff without worrying about doing any harm'.
(Harder, 2012, p. 75)

4.5.1.3. Viewing mistakes as positive learning experiences due to the feedback received. One of the key factors that appeared to offset negative feelings associated with making mistakes was receiving constructive feedback following the simulation. For example, Young et al. (2016) described how meaningful feedback provided 'a safety net' and helped participants view their mistakes as learning opportunities. Similarly, in Hughes et al.'s (2014) study, students felt that the negative impression of their SBL performance and their confidence was ameliorated, to some extent; by the positive feedback and reinforcement they received in the debrief.

'I think we got some very positive feedback on things as well and sort of boosted your confidence and made you think 'well I did do that bit ok and' it's this that I need to work on'.
(Hughes et al., 2014, p. 204)

When students did not feel 'judged' or threatened, and where their mistakes were discussed constructively they were more positive about their SBL experiences.

'I believe that the [simulations] were a very non-judging environment where you could have mistakes brought to your attention in a constructive as opposed to a confrontational way...'
(Young et al., 2016, p. 70)

4.5.2. The impact of errors on learning

4.5.2.1. Taking responsibility for mistakes. Mistakes made during simulations helped many participants recognise that seemingly minor issues or omissions can result in significant harm to patients (Bussard, 2015). Assuming responsibility for their mistakes also helped participants become cognizant of their role in the prevention of adverse patient outcomes in the future (Helyar et al., 2013; Song and Jeong, 2015).

'Making even a small mistake, could endanger or be lethal for a patient. Now I feel burdened and understand my responsibility'.
(Song and Jeong, 2015, p. 150)

'As a nurse, bearing in mind the professional code of practice you operate under, ...you have to make sure your practice is safe... it [the simulation] really ... embedded it'.
(Helyar et al., 2013, p. 16)

In a study that explored medical students' ($n = 98$) views of using virtual surgical patient cases to develop decision-making and diagnostic skills, Sullivan et al. (2016) identified that, despite being penalised by losing points for making mistakes during the simulation activities, students still felt it was a positive learning experience. They valued being independent and responsible for the patient cases; they did not feel embarrassed by making mistakes, but instead suggested that it helped them to realise that their decisions, right or wrong, have consequences.

4.5.2.2. Recognition of the potential impact of learning from mistakes on patient safety. Four of the included studies described how the errors made during SBL were a catalyst for learning and potentially, improved clinical practice. In Botezatu et al.'s (2010) study, medical students ($n = 16$) discussed how committing an error with virtual patients meant that they were less likely to make the same mistake in a clinical setting. Similarly, in a study of magnetic resonance imaging students ($n = 29$), Elshami and Abuzaid (2017) described how the majority (60%) valued SBL as it gave them an opportunity to learn from their mistakes and prevent future errors with real patients.

'I believe that simulation training decreases mistakes that I'm making in clinical training as I'm trying not to repeat the same mistakes again'.
(Elshami and Abuzaid, 2017, p. 156)

In a study with pre-registered nursing students ($n = 15$), Helyar et al. (2013) found that making mistakes helped students become knowledgeable about the importance of safe clinical practices.

‘...it really confirmed how important safety is. You have to do everything you possibly can to ensure your practice is safe... it is something that I took away from that and still practice, is still with me today’.

(Helyar et al., 2013, p. 15)

The findings from an interprofessional patient safety simulation with 262 undergraduate and postgraduate nursing and medical students illustrated how the emotions provoked by making a mistake alerted the participants to issues associated with patient safety and their own fallibility (Reime et al., 2016). Further, these emotions triggered the memory of the mistake following SBL and helped students recall similar experiences from both previous simulations and clinical practice (for example failing to check a patient's identification, which resulted in a blood transfusion error). Importantly, participants described how the negative feelings associated with making a mistake made the learning both meaningful and memorable and by so doing, facilitated transfer of learning to clinical practice.

‘I really got hit, I had even checked the name, I thought, but had not done it well enough. This experience was a real wake-up call. It is so easy to make mistakes. I have become more aware overall since, and have been more thorough when checking IDs’.

(Reime et al., 2016, p. 79)

Similarly, in Helyar et al.'s (2013) study, nearly all participants ($n = 9$ of 12) discussed how making mistakes helped to connect theory and practice, especially in checking procedures and its potential use in future clinical practices.

‘They [errors] were ones where I obviously hadn't realised how important some of the theory is, obviously about identification and things...We had always been told, but obviously the simulation brought it to my attention just that much more’.

(Helyar et al., 2013, p. 15)

4.5.2.3. Testing abilities and developing humility. Harder (2012) found that nursing students preferred to make and independently correct their mistakes rather than being guided by a simulation educator, as this gave them an opportunity to test their abilities. Similarly, in Young et al. (2016) study of medical students, the mistakes made during simulation activities helped participants develop humility, recognise the limits of their abilities and be more willing to ask for help.

‘After all medical students and doctors are humans so we are not expected to know everything but we are expected to be able to practice safely and be able to appreciate the limits of our abilities and seek help when appropriate’.

(Young et al., 2016, p. 70)

‘I soon realised this was an amazing learning opportunity where we didn't have to get everything right’.

(Young et al., 2016, p. 70)

4.5.2.4. Errors as a stimulus for developing confidence. Lendahls and Oscarsson (2017) and Song and Jeong (2015) described how making mistakes in SBL followed by opportunities for deliberate practice, improved nursing and midwifery students' confidence. The findings also indicated that the errors provided a stimulus for learning, both by observation and through repeated practice.

‘At first, we really messed up. I left after my team's performance and watched all the other teams. And I think the more I saw, the more I could build my confidence. I watched our second performance with my friends and while it was not excellent, it was better than earlier’.

(Song and Jeong, 2015, p. 151)

Young et al. (2016) documented similar findings with medical students.

‘Throwing us in the deep end was great for my confidence in the long run’.

(Young et al., 2016, p. 70)

4.5.2.5. Developing cognitive and metacognitive skills. Bond et al. (2004) described how emergency medicine residents ($n = 15$) reflected on their mistakes after the SBL activity, which facilitated a deeper understanding of the patient scenario and acted as a motivation for further learning. Participants also recognised that their mistakes provoked the use of cognitive and metacognitive strategies as they learned to ‘step back’ and ‘reassess their thought process’ (Bond et al., 2004). Helyar et al. (2013) also reported students' cognitive processes while reflecting on their mistakes.

‘It made you think more about things that could go wrong’.

(Helyar et al., 2013, p. 15)

5. Discussion

This integrative literature review sought to explore students' perceptions and experiences of making mistakes in SBL. Despite the lack of detailed impact assessment and to the depth of research about SBL on this area of learning, this integrative review presented research evidence that allowed a comprehensive understanding of the topic. The two overarching themes to emerge from the analysis of the included studies were the impact of errors on learners themselves and the impact of errors on their learning.

Literature has suggested that students, particularly those in the early stages of a healthcare degree, sometimes perceive or are taught that errors are negative experiences that should be avoided (Aubin and King, 2015; Conn, 2018; Warner, 2016). Consistent with these notions, this review identified that many students' held negative views about the errors they made during SBL (Harder, 2012; Helyar et al., 2013; Young et al., 2016). However, although feelings of frustration, guilt and fear were often reported by students, skilled educators were able to transform the mistakes into learning opportunities (Harder, 2012; Helyar et al., 2013; Hughes et al., 2014; Lendahls and Oscarsson, 2017; Song and Jeong, 2015; Young et al., 2016). Factors that students considered key to minimising the negative impact of errors and using them as stimuli for learning included the provision of a psychologically safe learning environment (Botezatu et al., 2010; Harder, 2012; Hughes et al., 2014; Young et al., 2016) where, instead of punitive responses from educators and/or peers, they were provided with meaningful feedback (Hughes et al., 2014; Young et al., 2016). These findings align with simulation literature suggesting that a safe learning experience is not limited to patient safety (Ganley and Linnard-Palmer, 2012), but involves the establishment of a supportive learning environment where students feel safe to take risks, to express feelings of vulnerability and to openly disclose their errors (Rudolph et al., 2014).

This review identified that debriefing sessions where mistakes were discussed in a constructive manner allowed students to perceive errors as learning opportunities (Harder, 2012; Helyar et al., 2013; Hughes et al., 2014; Lendahls and Oscarsson, 2017; Song and Jeong, 2015; Young et al., 2016) and promoted the development of emotional strategies that allowed them to respond to errors positively (Harder, 2012; Hughes et al., 2014; Sullivan et al., 2016; Young et al., 2016). This may be particularly important for performance-oriented individuals who try to avoid making mistakes (Van-Dyck et al., 2010).

The capacity to take responsibility for errors was frequently reported in the papers reviewed (Bussard, 2015; Helyar et al., 2013; Song and Jeong, 2015; Sullivan et al., 2016). In order to learn from mistakes,

students must recognise and take ownership of their errors (Fischer et al., 2006), as this helps them understand the personal impact of errors and their role in the prevention of adverse patient outcomes in the future (Helyar et al., 2013).

It is suggested in some studies that the negative feelings associated with making errors in SBL cannot and should not be completely removed (Rudolph et al., 2014), as the emotional consequences of errors make the learning experience both meaningful and memorable. Indeed, as some of the studies in this review have pointed out, students who commit errors and learn from them in SBL may be less likely to repeat the same mistakes in clinical settings (Elshami and Abuzaid, 2017; Helyar et al., 2013; Reime et al., 2016).

6. Limitations and implications

Grey literature and unpublished records were beyond the scope of this integrative review, and only studies published in English were included. Consequently, some relevant studies could have been missed. This review focused on healthcare students' views of making mistakes in simulation and other stakeholders were not included (for example, simulation educators), an issue which may limit insights into the current topic as a whole.

7. Conclusion

Despite the negative feelings experienced by some students regarding making mistakes in SBL, there were key factors that minimised the impact of these feelings and transformed mistakes into learning opportunities. These included: the provision of a safe and non-threatening learning environment where constructive feedback was provided by skilled educators, and where students were supported to take responsibility for their mistakes. The take-home message from this review is that it cannot be assumed that SBL is a safe experience where learners are able to make and learn from their mistakes. Optimising learning from mistakes in SBL requires a deliberate and thoughtful approach in which educators plan for and support learners to recognise, acknowledge and respond effectively to errors. Although the findings from this review indicate that students believe that making mistakes, under certain conditions, has potential learning benefits, how to incorporate errors as a deliberate teaching strategy in SBL and how to optimise learning from those errors should be the subject of future studies.

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Conflict of Interest

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Ethical Approval

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