International Journal of Learning, Teaching and Educational Research
Vol. 21, No. 4, pp. 1-27, April 2022
https://doi.org/10.26803/ijlter.21.4.1
Received Jan 26, 2022; Revised Mar 19, 2022; Accepted Apr 4, 2022

Pedagogical Practices for Organizing Simulation-Based Healthcare Education

Tuulikki Keskitalo
Lapland University of Applied Sciences
Rovaniemi, Finland

Abstract. Despite the positive findings on the results of simulation-based health-care education, what truly makes it successful remains unclear. We do not know enough about *when* and *how* the simulation-based learning environment (SBLE) should be applied. Thus, the specific aim of this thematic-review study was to determine *what* the facilitators' pedagogical activities are in the simulation-based education process. For this purpose, the study reviewed 83 previous studies in which the pedagogical practices were explained or examined. Based on the literature review, the pedagogical practices have been clearly linked to facilitators' activities before, during, or after simulation. Most of the research has focused on facilitators' activities during simulation-based education, especially during the debriefing phase. Some studies have examined pre-simulation activities, but the research concentrating on facilitators' post-simulation activities is limited. All in all, this thematic literature review provided insights on the successful pedagogical practices for implementing the simulation-based health-care education process. To further develop simulation-based health-care education and to optimize the use of such a learning environment, scholars should describe facilitators' and learners' activities more accurately; and they should use more rigorous research methods to analyze the teaching and the learning activities. Furthermore, such knowledge should be synthesized and used to develop pedagogical models and methods for simulation-based healthcare education and to integrate them into various learning contexts.

Keywords: learning theories; pedagogy; facilitation; practices; methods; thematic literature review

1. Introduction

In the last two decades, there has been growing interest in using simulations in healthcare education, in order to enhance learning, to improve learning experiences, and ultimately, to increase the quality of patient care and safety (Littlewood, 2011; Van Soeren et al., 2011; Ziv et al., 2000). However, simulation is a technique that must be used appropriately; and it must be tailored to the learning

(Chee, 2014; Clapper, 2010; Gaba, 2004; Harder, 2009; Jeffries, 2007). Thus, regardless of how advanced a simulation is, it will enhance learning only if it is used appropriately.

It is currently, generally accepted that the use of simulation in medical and healthcare education enhances the learning of medical (Swamy et al., 2013) and nursing students (Hope et al., 2011; Yue et al., 2022), as well as that of professionals in fields, such as emergency medicine, (Chakravarthy et al., 2011; Schroedl et al., 2012), anesthesia (Ramsingh et al., 2014) and surgery (Bearman et al., 2014; Nguyen et al., 2015).

Simulation-based education has been noted as being superior to basic lecture-style courses (Burden et al., 2014; McCoy et al., 2011; McGaghie et al., 2011); and it is well received by learners (Brewer, 2011; Hope et al., 2011; Konia & Yao, 2013; Solnick & Weiss, 2007; Swamy et al., 2013; Weller, 2004). Certain effects have also been demonstrated with regard to enhancing the efficiency of interprofessional team training (Batchelder et al., 2009; Gough et al., 2009). Moreover, the use of simulation has been shown to have moderate effects on clinical practice (Cook et al., 2011).

Specifically, simulation has reportedly improved learners' basic science knowledge, clinical skills, communication skills, and teamwork; and it has supported the formation and growth of confidence in one's professional identity (Berragan, 2011; Cant & Cooper, 2009; Chakravarthy et al., 2011; Davies et al., 2012; McGaghie et al., 2011; Norman et al., 2012; Paige & Daley, 2009).

The reason for the positive learning experience with simulation may be that simulation is an active learner-centered learning method, in which instruction can be tailored to meet the needs of the individual learners (Beauchesne & Douglas, 2011; Bland et al., 2011; Van Soeren et al., 2011). The widely cited review of Issenberg et al. (2005) found specific features that enhance learning in these novel learning environments, including feedback, repetitive practice, curriculum integration, a range of difficulty levels, multiple learning strategies, clinical variation, a controlled environment, individualized learning, defined outcomes, and simulation validity.

The systematic review by Cook et al. (2013) empirically supports nearly all these features. However, these reviews do not indicate specifically *how* these features should be implemented in practice. The facilitator's pedagogical thinking and decision-making have a marked influence on learning. However, pedagogical decisions and activities are rarely described in the research literature. As Garden et al. (2015) noticed, poor descriptions of pre-briefing activities can hamper the assessment of the influence of debriefing on learning (e.g., see also Leigh & Steuben, 2018).

Kolb's (1984) experiential learning theory, as well as Vygostky's (1978) ideas of learning, and the principles of adult learning (Knowles et al., 1998) have previously been seen to provide an appropriate framework for considering the use of

simulation in health-care education. Kolb's (1984) experiential learning model can be considered the first pedagogical model for guiding the simulation-based learning process; and it continues to inform simulation-based education practices in healthcare. Thereafter, a few more pedagogical models (e.g., Keskitalo, 2015a) have been designed to better address the special characteristics of the healthcare simulation context and to assist the meaningful learning of students. Pedagogical models practically describe how certain learning environments can be used and what type of learning they aim to support (Keskitalo, 2015a). With the help of the pedagogical model, simulation facilitators can actually root the learning in the proper context, frame their educational interventions with learning theories, and use techniques that are congruent with such theories.

Pedagogical models are also beneficial when structuring the simulation-based learning process. Usually, the simulation-based learning process is divided into four phases: the introduction, the simulator and scenario briefing, the scenarios, and debriefing.

Despite the existing models and the learning theories that are used to inform simulation-based education, the pedagogical foundation is still somewhat lacking in healthcare simulation research (Rivière et al., 2018). This complicates the evaluation of its intervention and results. As Cianciolo and Regehr (2019) wrote to deepen our understanding of learning in context and to draw proven educational implications from healthcare education research, we must now consider intervention in its wider educational framework. Only in that way we can know whether the intended intervention actually took place.

As noted, we often miss the strong pedagogical foundation of simulation-based healthcare education. In addition, we do not have a clear understanding of the facilitator's role or what pedagogical activities the intervention actually involved. In other words, we do not know enough about *how* the simulation-based learning environment (SBLE) is used (Cook et al., 2011; Garden et al., 2015; Cianciolo & Regehr, 2019; Issenberg et al., 2011). According to Ker (2012, p. 346), "There is a need to ask more *how* and *why* questions, as opposed to 'does this work?' or 'which is better?" Thus, what truly makes simulation-based education successful remains still unclear.

These findings, but also the researcher's observations, motivated me to study simulation-based education more closely from the facilitator's point of view, as the facilitator is responsible for planning, organizing, and evaluating simulation-based education. The focus of this thematic research review is to synthesize current knowledge regarding the pedagogical use of SBLE, in order to provide guidelines for healthcare simulation education practice, as well as ideas for future research. The specific aim is to determine *what* the facilitators' pedagogical activities are in the simulation-based learning process. The research question that this study attempts to answer is as follows: *What kind of pedagogical activities do healthcare facilitators perform during the simulation-based education process?*

Next, I present the review criteria and the methods. Then, I illustrate the synthesis of the pedagogical practices that facilitators have used to facilitate learning in this novel learning environment. Finally, I summarize the results, highlight the gaps in our understanding, and suggest some insights for future research.

2. The Review Method

This thematic review (e.g., Attride-Stirling, 2001) aims to examine the pedagogical practices of simulation-based healthcare education from the perspective of the healthcare simulation facilitator. This review is not intended to be complete; as there are numerous studies on simulation in healthcare and medical education (e.g., an August 2020 the online database search of ScienceDirect from 2000 to 2021 resulted in 115,044 journal articles related to simulations and education) (cf. Fanning & Gaba, 2007). As, the aim is to investigate and understand the present issue, in order to provide healthcare facilitators with theoretical viewpoints, guidelines, and best practices for organizing simulation-based healthcare education, and of course, to guide future research. Therefore, we considered thematic analysis a useful method for this review; since it provides enough guidance for the researcher; but it is also flexible in nature to capture the complexity of the issue and to reflect the current reality. All in all, thematic analysis can be defined as a method of identifying, analyzing, and reporting patterns in the data (Attride-Stirling, 2001).

The research data were collected in four steps. The first data collection period was in spring 2015 (see Keskitalo, 2015b); the second, in autumn 2016; the third, in autumn 2017, and the last, in spring 2022. The reason for the multiple steps was the author's inability to continuously perform the data collection and analysis, due to the intermittent research funding and the researcher's variable workload.

The literature search was conducted with an electronic search platform, which made it possible to search multiple databases simultaneously. The databases searched were BioMed, DOAJ, PsycINFO (ProQuest), Social Sciences Premium Collection (ProQuest), PubMed, ScienceDirect (Elsevier), Academic Search Elite (EBSCOhost), and SpringerLink. Multiple search terms ("simulation," "simulation-based medical education," "simulation-based healthcare education," "learning theories," "pedagogy," "method", "strategy", "practice", "teaching," "facilitation," "instruction," and "learning") were used in a mixed setup with the Boolean word. The initial search produced 11,242 articles, including duplicates from overlapping searches. Then, we analyzed the titles, the abstracts, and the keywords of the studies, and this narrowed the corpus down to 202 articles.

The literature for this thematic analysis (see Attride-Stirling, 2011; Braun & Clarke, 2014; Hämäläinen & Vähäsantanen, 2011; Irby, 1995) was selected, based on the following predefined inclusion criteria: (1) the articles were written in English; (2) the articles discussed the learning theoretical backgrounds, pedagogical models, methods, practices or strategies used in simulation-based healthcare education; (3) the participants were students in higher education or adult professionals in medicine or healthcare (mainly nursing); and (4) the methodological underpinning of the articles could be in any form (qualitative, quantitative, mixed methods, review, theoretical, and commentaries) that could help us to answer the research

question. The search was not restricted to the year in which the article was published, because the first publications on simulation-based education appeared in the 1980s, (Gaba & DeAnda, 1988).

After closely reading 202 articles, a total of 83 articles that illustrated the pedagogical practices of simulation-based healthcare or medical education were selected on the basis of the above-mentioned inclusion criteria. Thereafter, the literature was coded and analyzed using colored pencil and an Excel sheet based on the basic information and the research question. During the analysis, I first read, and at the same time highlighted the concepts and ideas that directly answered or provided relevant insights into the research question. During this process, the codes were also written and saved in a separate Excel sheet, which made it possible to modify them later in this iterative analytical process. Basic information included the publication year, the names of the authors, the journal, the type of text, the methods used, and the participants. Based on the research question, pedagogical information included the facilitator's pedagogical activities before, during and after simulation-based learning.

The analysis of the 83 articles (see Appendix 1, the list of all the included articles) was also deductive in nature; since the themes were based on the previous research literature; for example, the phases of the simulation-based healthcare education and the facilitator's role during these phases. As a result of the iterative data analytical process, we discovered the following themes in relation to our research question: (1) the facilitator's pre-simulation activities: designing a meaningful and safe learning experience; (2) introduction: setting the ground for the learning experience; (3) pre-briefing: facilitating familiarization; (4) scenario: facilitating the active participation of the learners; (5) debriefing: facilitating reflection on the learning experience; and (6) the facilitator's post-simulation activities: reflecting and developing simulation-based education.

Of the 83 articles, 15 were reviews, 18 were quantitative, 21 were qualitative, and 4 were mixed-method (mixing both quantitative and qualitative) articles. However, most of the selected articles were theoretical or commentaries (n = 25). The selected articles were published between 2000 and 2022 in 34 different journals, thus representing a multidisciplinary approach to the topic. The participants in the empirical studies were mostly healthcare personnel (e.g., teams in hospital operating rooms) and medical or nursing students. In some of the selected studies, the participants were simulation facilitators or residents. Next, we focus on the pedagogical foundations of simulation-based healthcare education and the facilitator's role as a conductor of the learning processes.

3. Results – Pedagogical Practices in Simulation-based Teaching and Learning

In the articles reviewed, pedagogical practices have been clearly linked to activities before, during, or after simulation, thereby providing us with a natural way to thematize them. Most research focused on what facilitators should do during simulation-based education, especially during the debriefing phase. Some studies have examined pre-simulation activities; however, research concentrating on facilitators' post-simulation activities is scarce (see also Leigh & Steuben, 2018). To

further understand the facilitator's role, as a conductor of the learning process, the pedagogical activities during the actual, face-to-face simulation-based education have been further analyzed in relation to the simulation-based pedagogical models that divide simulation-based learning into separate phases (introduction, simulator briefing, scenarios, and debriefing).

3.1. The Facilitator's Pre-simulation Activities – Designing a Meaningful and Safe Learning Experience

According to the literature, pre-simulation activities demand much work from the facilitators. Facilitators must consider the target group (usually adult learners) and what kind of training should be provided to this group. Secondly, an important task is to design the learning objectives for the course with these individual learners in mind. Thirdly, a facilitator should design the case scenario, while considering the learners and the learning goals.

Case scenarios and their design have been the subject of the debate in the healthcare simulation field. According to the literature, high simulation realism (high fidelity) has often been a priority in simulation-based education because it can increase the learners' immersion in the situation; although it is not self-evident that high fidelity enhances learning. This controversy can be explained by a study of Rystedt and Sjöblom (2012), who argued that the realism of a scenario cannot be planned too strictly in advance, as the situation develops and changes in the interactions during the simulation. However, scholars agree that the realism of the case scenario must be tailored to the goals of the simulation and the participants' competence levels, and that the complexity should increase gradually as the learners' competences develop.

In his theoretical article, Alinier (2011) wrote that more realistic case scenarios often require more time to prepare, as there are many factors to consider. In addition, the higher that the fidelity of the simulations is, the more advanced and skillful the learners must be, as they must demonstrate not only theoretical knowledge (know-how), but also practical knowledge (show-how and do) (see also, Tremblay et al., 2019). According to the literature, adding emotional stressors to simulation scenarios has also been shown to enhance learning.

In addition to designing the case scenario, other critical considerations include designing the learning environment and selecting the devices and possible role players for the scenarios. Facilitators must also consider whether pre-assignments or readings are valuable; since these can enhance learning and affect learners' expectations (e.g., Moll-Khoswari et al., 2021). Finally, facilitators must script and time the learning event appropriately. Pedagogical models and Kolb's (1984) experiential learning cycle have been noted to be useful in this regard.

3.2. Introduction Phase – Setting the Ground for the Learning Experience

Simulation-based education usually starts with an *introduction*, which Arthur et al, (2013) viewed as a highly important phase for preparing participants for the learning experience. During the *introductory phase*, the participants become familiar with one another; the facilitator also explains what the course is about; and s/he presents the learning objectives during this phase. Some studies also noted

that in the first phase, the stimulation of learners' previous knowledge and experiences is an important prerequisite for their future learning, the formation of the learning objectives, and aids in answering students' questions.

However, the most important goal in the introductory phase is to create a psychologically safe and non-threatening atmosphere for learners, because participating in the simulation can be stressful (e.g., LeBlanc & Posner, 2022). According to the literature, there is no explicit or proven way to foster such an atmosphere; however, some techniques have been proposed. Firstly, the facilitator should explain to the students that simulation-based learning would help them to maintain their skills and knowledge, and also to acquire new ones. If the simulation is not for assessment purposes, this should be clearly stated; and, of course, vice versa. The facilitator should also state that in the SBLE, students can make mistakes without adverse consequences; and such mistakes can be used as opportunities for learning. Moreover, in a simulation setting, feedback is given about the performance, rather than the performer. The facilitator should also clarify that simulation-based learning is confidential and that participants should not break that rule.

In the study of Zigmont et al. (2011a), the use of a written confidentiality agreement proved to be useful in protecting individuals and their privacy, and in ensuring that the participants felt safe during the learning process. Van Soeren et al. (2011) also found that facilitators who had adopted a student-centred approach to the learning process actually sat down with the students, used humor and empathy, and shared their own experiences with the students. Thus, to ensure a positive atmosphere, the facilitator should encourage pleasant, secure, open, and personal interactions. Walton et al. (2011) noted that facilitators should use welcoming voices and postures. However, facilitators should also be prepared to deal with students who are unwilling to participate.

3.3. The Pre-briefing Phase – Facilitating Familiarization

The *simulator and scenario briefing,* that is, the pre-briefing phase, takes place after the introduction. In this familiarization phase, the participants get to know the physical environment, the case scenario that will be handled, the goals of the simulation exercise, their roles, and the rules to be followed during the exercise. This phase is important, so that the learners would understand how to handle the simulation and how they are expected to interact with the environment and with other learners, or possible role-players. It is also important that students should have hands-on time with the simulation; since they must recognize the differences between the simulation and working with real patients.

When introducing the scenario, the facilitator can use fictitious problems or real-world examples as learning triggers. S/he can also show video clips of the correct performance for a more detailed demonstration (e.g., Jarvill & Krebs, 2018). Power et al. (2016) also suggested using patients' stories, in order to enhance learners' emotional engagement with mannequins. All of these helps put participants in the right mood for the exercise and improve their motivation. Research literature also suggests that procedures and any decisions that the participants would be

required to make should be introduced at a general level, in order to avoid spoiling the surprise elements of the simulation experience.

3.4. The Scenario Phase – Facilitating the Active Participation of Learners

In the *scenario* phase, the learners participate in the case scenario and take the active role. The case scenarios are usually handled in small groups of preferably three to four participants. In the scenario phase, more often, the facilitators' role is to stay on the sidelines and monitor the participants' behaviors. However, if the scenario is going in the wrong direction, some authors suggest that the facilitator should step in and direct the scenario to ensure that the participants still achieve the learning objectives.

On the other hand, some authors suggest that interruptions should always be avoided, in order to maintain the realism in the simulation. For example, Garrett et al. (2011) found that students prefer that facilitators should take on a secondary role, as students are eager to see the impacts of their actions on the condition of the "patient".

This may also enhance student learning, as the study of Goldberg et al. (2015) study showed (see also Bearman et al., 2019). Previous studies have reported that compared with professionals, novices benefit from and prefer more explicit instructions, which might indicate that the former could benefit from the facilitators' interruptions. As noted, a somewhat controversial issue exists in relation to this topic. However, according to Dieckmann et al., (2007) explicitly terminating the case scenario is important for learning, despite the acknowledged competence level of the simulation participants.

An important question about the scenario phase is whether active participation has a greater impact on learning than mere observation. According to Lai et al. (2016), learning outcomes do not improve when learners are active participants versus when they are mere observers.

3.5. Debriefing Phase – Facilitating Reflection on the Learning Experience

Debriefing is the final phase of simulation-based education; and it is commonly regarded as the most important one. Scholars have proposed different models for conducting the debriefing phase. To date, no clear evidence has been presented to prove that any one particular method is better than another (e.g., Dufrene & Young, 2014). However, there is evidence that feedback is essential for enhancing learning (e.g., Issenberg et al., 2005; Tutticci et al., 2018). Process-oriented feedback is considered particularly valuable when learning complex tasks, such as crisis-resource management. Specific individualized feedback is also valued by learners and facilitators. The most common and effective method is to debrief learners immediately after the simulation scenario in a private and peaceful place, which helps to maintain the safe learning environment. The time required for debriefing depends on various factors; however, Kilhgren et al. (2015) noted that a more in-depth analysis requires a longer time for discussion.

The goal of the debriefing is usually for the participants to share their feelings, to review their understanding and skills, and to formulate new learning objectives.

To encourage these issues, the facilitator may help the participants explore their decisions and actions during the scenario in a supportive and humorous manner, which is why Rudolph et al. (2008) described the facilitator's role during the debriefing as that of a "cognitive detective." Open-ended questions and active listening have been proposed, as valuable techniques that can be used by facilitators when debriefing. Facilitators should also be able to engage both the active participants and the observers to support the goal of collaborative learning.

This is because the most active participants in the scenarios also tend to be the most active in the debriefing. During the debriefing, facilitators may use video feedback from the performance, which has been shown to be beneficial and valuable for learners; since it provides more realistic and accurate feedback on their performance. However, Garden et al. (2015) and Levett-Jones and Lapkin (2014) found contradictory results regarding the use of videos in the debriefing. Some authors also argued that such a feedback should be used carefully, in order to avoid boredom or humiliation. Cheng et al. (2014) found that the effectiveness of video playback may be related to the learners, the topic, or the method of video use.

Many articles cited the Steinwachs' (1992) three-phase model of debriefing, which is commonly used within simulation-based healthcare education. The first phase in the three-phase debriefing model is *the descriptive phase,* in which the learners describe what happened and share their first impressions and feelings regarding the scenario. The typical question in this phase is, "What happened?" According to Gardner (2013, p. 169), "this phase allows for participants to vent and blow off a little steam." However, there might be cultural differences in the discussion of emotions. Dieckmann and Rall (2007), proposed that every debriefing should start with the facilitators asking the participants about their views on the scenario; because the participants do not necessarily experience the scenario in the way that the facilitators expect.

In the next phase of debriefing, *the analytical phase*, the participants go deeper into the scenario, in order to figure out the reasons for their decisions and actions. A typical comment in this phase could be: "Tell me about your thought process;" or "Show me how you came to that decision." The goal of this phase is to help the participants figure out *why* they did *what* they did, and *how* they can change their mental models to behave differently next time. In other words, during this phase, the facilitator usually seeks to examine the mental models behind the participants' performance, in order to reveal each participant's knowledge gaps, thereby creating new understanding and practices.

According to Cheng et al. (2014), it is also important that facilitators should use the "I" perspective to reveal their own thoughts, in order to model expert reasoning. Thus, the facilitators first state their own perceptions of the case scenario; and then they ask the participants about their thoughts and perceptions during the simulation. The facilitators should also try to help the participants to relate their actions to previous experiences and knowledge to offer explanations for their actions.

During the *application phase*, learners consider what they can take home from the learning experience, what they can apply to actual clinical practice, and how they can assume responsibility for their own learning after the simulation exercise. Interestingly, Nyström et al. (2016) argued that this kind of scripted debriefing, as proposed by Steinwachs (1992), does not necessarily allow room for learners' initiative, thus making it a more teacher-centered approach to learning. This perspective contradicts the ideas of many simulation researchers, who argue that individual learners and their learning needs should be fully considered during the debriefing process. Dieckmann et al. (2012) also found that facilitators are more actively involved than desired, indicating thereby that debriefing may not always be performed in an ideal manner.

3.6. The Facilitator's Post-Simulation Activities – Reflecting and Developing Simulation-based education

Facilitators' post-simulation activities are important for the development of simulation-based education, and for their own roles as facilitators of the learning process. Basically, post-simulation activities are those that happen after the actual simulation session. However, this point is rarely discussed in the research literature. Wang (2011) proposed two frameworks, namely, those of Kirkpatrick (1998) and Kneebone (2005), which could help facilitators to evaluate and develop their own expertise and education. According to Keskitalo et al. (2014), the principles of meaningful learning can also be used to evaluate simulation-based healthcare education. They proposed 14 characteristics that can be used to evaluate, develop, plan, and implement education. These characteristics help to identify the gaps that must be reconsidered and developed in education, thereby ensuring that a more holistic and meaningful approach to teaching and learning in SBLEs is adopted. In the same year, Franklin et al. (2014) developed a simulation-design scale that can also be used for assessing students' self-confidence, simulation design and educational practices.

4. Discussion

4.1 The Main Findings

This study sought to review those concrete pedagogical practices that are influenced by the learning theories and multiple contextual factors. Based on the iterative data-analytical process, we identified six themes that helped us to answer the research question, namely: (1) the facilitator's pre-simulation activities: designing a meaningful and safe learning experience; (2) introduction: setting the ground for the learning experience; (3) pre-briefing: facilitating familiarization; (4) scenario: facilitating the active participation of learners; (5) debriefing: facilitating reflection on the learning experience; and (6) the facilitator's post-simulation activities: reflecting and developing simulation-based education. Themes clearly depict the aims of the different phase, thereby aiming to aid participants' learning.

Based on this review, there were articles that provided more in-depth understanding of facilitators' pedagogical activities. According to these articles, facilitators play a significant role in planning, implementing, and evaluating simulation-based education. There are numerous practical tips on how to plan simulation-

based education and what it requires from facilitators (e.g., Alinier, 2011; Motola et al., 2013). However, actual pedagogical practices are still somewhat vague; as the descriptions of the theoretical background, structures, and methods are often missing, or they lean toward simulation-based teaching and learning interventions, thus making it difficult to compare the educational processes and to determine which processes eventually lead to successful practice (Levett-Jones, & Lapkin, 2014; Cheng et al., 2014). This study also showed that tools and methods for evaluating and reflecting simulation-based education are scarce; but they would be very helpful for striving for excellence in healthcare teaching.

Simulation-based education is often divided into four phases, in which debriefing has gained an enormous amount of attention. However, we also think that simulation-based learning should be considered in its entirety, in order to develop simulation-based healthcare education and evidence-based implications that are feasible in practice. Debriefing is important, but it cannot stand alone (cf. Garden et al., 2015). For example, the pre-briefing can already set the tone for the whole simulation exercise; and it may affect the depth of the discussion. Therefore, to understand simulation-based learning, we should also understand the whole process, which requires a rigorous description of the participants' activities. In the articles, the simulation facilitator's roles have been described as those of an organizer, a co-learner, a tutor, and even a "cognitive detective" (Rudolph et al., 2008). These role descriptions depict the approach that is considered the most functional and efficient in SBLE. In summary, a facilitator should adopt a student-centered approach to learning in order to design meaningful simulation-based learning opportunities for participants. In practice, this means finding a balance between participants' needs, pedagogical design, and other different necessities.

4.2 Limitations

This study had limitations that must be addressed. Firstly, it began with the notion of the author (who is an educational scientist himself) that simulation-based education is rarely grounded in learning theories or pedagogical principles. Thus, the author's own preconceptions might have influenced the results. However, this was also why we wanted to conduct an extensive data collection and analysis. Secondly, although we conducted an extensive literature search, we might have inadvertently excluded some articles that should have been part of the analysis; for example, due to the combination of the search terms. Thirdly, the analysis included all articles, including commentaries and theoretical contributions, that described pedagogical practices used or suggested for simulation-based healthcare education.

Therefore, some of the pedagogical practices described in the article may definitely need more research. However, we think these articles were important to include, because many of their authors of those articles have extensive expertise in the field, and their thoughts and reasoning would add important contributions to the field and may provide to the field some "food for thought" or completely new directions for discussion, research, or practice. In this way, we were also able to better address the current situation and to have ongoing discussions within the field. However, we also believe this review article makes an important

contribution to the field; as the descriptions of the theories and the pedagogical design in the field are still limited and need more attention.

Fourthly, the analysis was conducted using thematic analysis, which is a useful and flexible method of analyzing qualitative data. However, due to its flexibility, there could be a lot of variation in its use, and much depends on the analytical skills of the researchers. However, we think this long and in-depth research process has provided us with enough time to think through and correct our interpretation, thereby providing the readers with more reliable results. However, in the future, it might be necessary to apply a more systematic approach to validate the results of this study.

4.3. Future Research and Practical Implications

Thus far, numerous studies have shown that simulation is an effective learning tool; and that simulation technology actually works (Cook et al., 2011). However, to provide answers, especially to the questions of how and why it works, more research is needed. This is because many studies lack the description of the facilitators' and the learners' activities during the simulation-based education (Levett-Jones & Lapkin, 2014; Cheng et al., 2014).

Firstly, future studies should explain the guiding learning theoretical framework and pedagogical practices in greater detail, and how exactly these are implemented during simulations. In addition, the role of facilitators and learners in simulation-based education should be described in a more detailed manner. For example, Garden et al. (2015) pointed out that we need a more rigorous description of how the other parts of simulation sessions are conducted to explore the efficiency of debriefing.

In this regard, the application of more innovative and creative research methods would be helpful. For example, from the articles chosen for this review, only four used mixed methods. This is a clear deficiency. On the one hand, design-based research studies would be helpful (Barab & Squire, 2004); as their purpose is to develop theory and practice in the iterative cycles of design, implementation, analysis, and redesign in collaboration with practitioners. On the other hand, analytical methods, such as video ethnography and discourse analysis, may help to reveal the underlying processes that make simulations so successful for learning.

For example, discourse analysis might be useful in determining what kinds of dialogues enhance trust and safety among the simulation participants. In conclusion, simulation-based healthcare education would benefit from mixed-method studies that describe the pedagogical grounding and intervention in a more detailed manner. Only through this approach can we find out what kinds of practices could generate the most valuable results. For example, we do not really know which model or method is the most appropriate for specific types of learners (Dufrene & Young, 2014). Therefore, in future studies, researchers should compare these different pedagogical models and methods with various participants, in order to determine which of these is the most successful. The findings of such works could eventually lead to improved performance in real practice.

In addition to the learning theories, which have already been presented in this study, the cognitive-load theory could be helpful in conducting simulation-based learning research, which could provide us with a better understanding of the individual perspectives on learning (Issenberg et al., 2011; Allvin et al., 2017). For example, such research could help us to explain the relationship between emotions and performance in simulation-based learning. In addition, the socio-cultural theory and socio-material perspectives might help us to understand simulation-based learning as a social practice, how events actually evolve in a simulation, and, for example, how the physical environment prevents or fosters learning.

For instance, given that simulation fidelity has long been debated in the field, the socio-material perspective might help us to address questions about this topic, such as why high fidelity does not necessarily lead to better immersion and learning outcomes. Is there something in the simulation environment itself that we must consider? Furthermore, we could provide more comprehensive answers to our research questions by combining more than one perspective in research design. Thus, a multi-disciplinary approach to studying and applying simulation-based education is also needed.

Most researchers and practitioners agree that in simulation-based education, the *introduction, simulator and scenario briefing, scenarios,* and *debriefing phases* should be present (e.g., Dieckmann, 2009; Keskitalo, 2015). Among these, debriefing has received the most attention. However, for the future development of simulation-based healthcare education, it would be interesting to examine how we could successfully implement the other phases, in order to enhance meaningful simulation-based learning. Thus, an important question in future studies could be related to, for example, how we can best organize participants' pre-briefings to create safe environments for learning. Future studies should also concentrate on the pedagogical thinking of healthcare simulation facilitators, that is, their conceptions and beliefs about teaching and learning. Research on this topic is scarce (Allvin et al., 2017; Laksov et al., 2008). However, pedagogical thinking affects facilitators' pedagogical decision-making, and subsequently, the learners' achievements also (Laksov et la., 2008).

5. Conclusion

The aim of this thematic review study was to question the facilitators' pedagogical activities during the simulation-based education process. For this purpose, the study reviewed 83 previous studies, in which the pedagogical practices were explained or examined. Based on the iterative data-analytical process, we discovered the six themes in relation to our research question. These themes depict the roles and the most important pedagogical practices that the simulation facilitator performs during each phase. Besides the numerous practical tips, we also acknowledged that the pedagogical practices have been clearly linked to facilitators' activities before, during, or after simulation. Most of the research has focused on facilitators' activities during simulation-based education, especially during the debriefing phase, but studies regarding pre-simulation or post-simulation activities are lacking.

To conclude, this thematic literature review provided insights into the pedagogical practices for implementing the simulation-based healthcare education process. To further develop simulation-based healthcare education and to optimize the use of such a learning environment, scholars should describe facilitators' and learners' activities more accurately; and they should use more rigorous research methods to analyze the teaching and learning activities. Then, such knowledge should be synthesized and used to develop pedagogical models and methods for simulation-based healthcare education and to integrate them into various learning contexts. Examining the learning theories, or the facilitator's pedagogical practices in simulation-based healthcare education is essential, in order to understand why, when, and how to integrate healthcare simulation into the curricula, and to use them in practice.

Declaration of Interest: The author reports no conflicts of interest.

6. References

Alinier, G. (2011). Developing high-fidelity healthcare simulation scenarios: A guide for educators and professionals. *Simulation Gaming*, *42*(1), 9–26. https://doi.org/10.1177/1046878109355683

Allvin, R., Berndtzon, M., Carlzon, L., Edelbring, S., Hult, H., Hultin, M. et al. (2017). Confident but not theoretically grounded: Experienced simulation educators' perceptions of their own professional development. *Advances in Medical Education and Practice*, *8*, 99–108. https://doi.org/10.2147/AMEP.S123517

Arthur, C., Levett-Jones, T., & Kable, A. (2013). Quality indicators for the design and implementation of simulation experiences: A Delphi study. *Nurse Education Today*, *33,* 1357–1361. https://doi.org/10.1016/j.nedt.2012.07.012

Attride-Stirling, J. (2001). Thematic networks: An analytic tool for qualitative research. *Qualitative research*, *1*(3), 385–405. https://doi.org/10.1177/146879410100100307

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences, 13*, 1–14. https://doi.org/10.1207/s15327809jls1301_1

Batchelder, A. J., Steel, A., Mackenzie, R., Hormis, A. P., Daniels, T. S., & Holding, N. (2009). Simulation as a tool to improve the safety of pre-hospital anaesthesia – A pilot study. *Journal of the Association of Anaesthetists of Great Britain and Ireland*, *64,* 978–983. https://doi.org/10.1111/j.1365-2044.2009.05990.x

Beauchesne, M. A., & Douglas, B. (2011). Simulation: Enhancing Pediatric, Advanced, Practice Nursing Education. *Newborn & Infant Nursing Reviews*, *11*(1), 29–34. https://doi.org/10.1053/j.nainr.2010.12.009

Bearman, M., Greenhill, J., & Nestel, D. (2019). The power of simulation: a large-scale narrative analysis of learners' experiences. *Medical Education, 53,* 369–379. https://doi.org/ 10.1111/medu.13747

Bearman, M., O'Brien, R., Anthony, A., Civil, I., Flanagan, B., Jolly, B., Birks, D., Langcake, M., Molloy, E., & Nestel, D. (2014). Learning surgical communication, leadership and teamwork through simulation. *Journal of Surgical Education*, *69*(2), 201–206. https://doi.org/10.1016/j.jsurg.2011.07.014

Berragan, L. (2011). Simulation: An effective pedagogical approach for nursing? *Nurse Education Today*, *31*, 660–663. https://doi.org/10.1016/j.nedt.2011.01.019

Bland, A., Topping, A., & Wood, B. (2011). A concept analysis of simulation as a learning strategy in the education of undergraduate nursing students. *Nurse Education Today*, *31*, 664–670. https://doi.org/10.1016/j.nedt.2010.10.013

Braun, V., & Clarke, V. (2014). What can "thematic analysis" offer health and wellbeing researchers? *International Journal of Qualitative Studies on Health and Well-being 9*(1), 1–2. https://doi.org/10.3402/qhw.v9.26152

Brewer, E. P. (2011). Successful techniques for using human patient simulation in nursing education. *Journal of Nursing Scholarship*, *43*(3), 311–317. https://doi.org/10.1111/j.1547-5069.2011.01405.x

Burden, A. R., Pukenas, E. W., Deal, E. R., Coursin, D. B., Dodson, G. M., Staman, G. W., Gratz, I., & Trojman, M. C. (2014). Using simulation education with deliberate practice to teach leadership and recourse-management skills to senior residents' code leaders. *Journal of Graduate Medical Education*, *9*, 463–469. https://doi.org/10.4300/JGME-D-13-00271.1

Cant, R. P., & Cooper, S. J. (2009). Simulation-based learning in nurse education: Systematic review. *Journal of Advanced Nursing*, *39*(2), 3–15. https://doi.org/10.1111/j.1365-2648.2009.05240.x

Chakravarthy, B., Ter Haar, E., Bhat, S. S., McCoy, C. E., Denmark, T. K., & Lotfipour, S. (2011). Simulation in medical school education: Review for emergency medicine. *The Western Journal of Emergency Medicine*, *12*(4), 461–466. https://doi.org/10.5811/westjem.2010.10.1909

Chee, J. (2014). Clinical simulation using deliberate practice in nursing education: A Wilsonian concept analysis. *Nurse Education in Practice*, *14*, 247–252. https://doi.org/10.1016/j.nepr.2013.09.001

Cheng, A., Eppich, W., Grant, V., Sherbino, J., Zendejas, B., & Cook, D. A. (2014). Debriefing for technology-enhanced simulation: A systematic review and meta-analysis. *Medical Education*, *48*, 657–666. https://doi.org/10.1111/medu.12432

Cianciolo, A.T, & Regehr, G. (2019). Learning theory and educational intervention: producing meaningful evidence of impact through layered analysis. *Academic Medicine, 94*(6), 789–794. https://doi.org/10.1097/ACM.0000000000002591

Clapper, T. C. (2010). Beyond Knowles: What those conducting simulation need to know about adult learning theory. *Clinical Simulation in Nursing*, *6*, e7–e14. https://doi.org/10.1016/j.ecns.2009.07.003

Cook, D. A., Hamstra, S. J., Brydges, R., Zendejas, B., Szostek, J. H., Wang, A. T., Erwin, J. P., & Hatala, R. (2013). Comparative effectiveness of instructional design features in simulation-based education: Systematic review and meta-analysis. *Medical Teacher*, *35*, 844–875. https://doi.org/10.3109/0142159X.2012.714886

Cook, D. A., Hatala, R., Brydges, R., Zendejas, B., Szostek, J. H., Wang, A. T., Erwin, P. J., & Hamstra, S. J. (2011). Technology-enhanced simulation for health professions education: A systematic review and meta-analysis. The Journal of the American Medical Association (JAMA), 306(9), 979–988. https://doi.org/10.3109/0142159X.2012.714886

Davies, J., Nathan, M., & Clarke, D. (2012). An evaluation of a complex simulated scenario with final year undergraduate children's nursing students. *Collegian*, *19*, 131–138. https://doi.org/10.1016/j.colegn.2012.04.005

Dieckmann, P. (2009). Simulation settings for learning in acute medical care. In P. Dieckmann (Ed.), *Using Simulations for Education, Training and Research* (pp. 40–138. Pabst Science Publishers.

Dieckmann, P., Friis, S. M., Lippert, S. M. F., & Østergaard, D. (2012). Goals, success factors, and barriers for simulation-based learning: A qualitative interview study in healthcare. *Simulation & Gaming*, *43*(5), 627–647. https://doi.org/10.1177/1046878112439649

Dieckmann, P., Gaba, D., & Rall, M. (2007). Deepening the theoretical foundations of patient simulation as social practice. *Simulation in Healthcare*, *2*, 183–193. https://doi.org/10.1097/SIH.0b013e3180f637f5

Dieckmann, P., & Rall, M. (2007). Simulators in anaesthetic training to enhance patient safety. In J. N. Cashman & R. M. Grounds (Ed.), *Recent advances in anesthesia & intensive care 24* (pp. 211-232). Cambridge University Press.

Dufrene, C., & Young, A. (2014). Successful debriefing – Best methods to achieve positive learning outcomes: A literature review. *Nurse Education Today*, *34*(3), 372–376. https://doi.org/10.1016/j.nedt.2013.06.026

Fanning, R. M., & Gaba, D. M. (2007). The role of debriefing in simulation-based learning. *Simulation in Healthcare*, *2*, 115–125. https://doi.org/10.1097/SIH.0b013e3180315539

Franklin, A. E., Burns, P., & Lee, C. S. (2014). Psychometric testing on the NLN Student Satisfaction and Self-Confidence in Learning, Simulation Design Scale, and Educational Practices Questionnaire using a sample of pre-licensure novice nurses. *Nurse Education Today, 34*(10), 1298–1304. https://doi.org/10.1016/j.nedt.2014.06.011

Gaba, D. (2004). The future vision of simulation in health care. *Quality and Safety in Healthcare*, *13*(1), 2–10. https://doi.org/10.1136/qshc.2004.009878

Gaba, D.M., & DeAnda, A. (1988). Comprehensive anesthesia simulation environment: recreating the operating room for research and training. *Anesthesiology, 69*(3), 387–394. https://doi.org/10.1097/00000542-198809000-00017

Garden, A. L., Le Fevre, D. M., Waddington, H. L., & Weller, J. M. (2015). Debriefing after simulation-based non-technical skill training in healthcare: A systematic review of effective practice. *Anaesthesia Intensive Care*, *43*(3), 300–308. https://doi.org/10.1177/0310057X1504300303

Gardner, R. (2013). Introduction to debriefing. *Seminars in Perinatology*, *37*, 166–174. https://doi.org/10.1053/j.semperi.2013.02.008

Garrett, B. M., MacPhee, M., & Jakcson, C. (2011). Implementing high-fidelity simulation in Canada: Reflections on 3 years of practice. *Nurse Education Today, 31*, 671–676. https://doi.org/10.1016/j.nedt.2010.10.028

Goldberg, A., Silverman, E., Katz, D., Lin, H. M., Levine, A., & DeMaria, S. (2015). Learning through simulated independent practice leads to better future performance in a simulated crisis than learning through simulated supervised practice. *British Journal of Anaesthesia*, *114*(5), 794–800. https://doi.org/10.1093/bja/aeu457

Gough, S., Hellaby, M., Jones, N., & MacKinnon, R. (2012). A review of undergraduate interprofessional simulation-based education (IPSE). *Collegian*, *19*, 153–170. https://doi.org/10.1016/j.colegn.2012.04.004

Harder, N. B. (2009). Evolution of simulation use in healthcare education. *Clinical Simulation in Nursing*, *5*, 169–172. https://doi.org/10.1016/j.ecns.2009.04.092

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. https://doi.org/10.1016/j.nedt.2010.12.011

Hämäläinen, R., & Vähäsantanen, K. (2011). Theoretical and pedagogical perspectives on orchestrating creativity and collaborative learning. *Educational Research Review, 6,* 169–184. https://doi.org/10.1016/j.edurev.2011.08.001

Irby, D. M. (1995). Teaching and learning in ambulatory care settings: A thematic review of the literature. *Academic Medicine*, *70*(10), 898–931. https://doi.org/10.1097/00001888-199510000-00014

Issenberg, S. B., McGaghie, W. C., Petrusa, E. R., Gordon, D. L., & Scalese R. J. (2005). Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review. *Medical Teacher*, *27*, 10–28. https://doi.org/10.1080/01421590500046924

Issenberg, S. B., Ringsted, C., Østergaard, D., & Dieckmann, P. (2011). Setting a research agenda for simulation-based healthcare education. A synthesis of the outcome from an Utstein-style meeting. *Simulation in Healthcare*, *6*, 155–167. https://doi.org/10.1097/SIH.0b013e3182207c24

Jarvill, M., & Krebs, H. (2018). Effect on Expert Role Modeling on Skill Performance in Simulation. *Clinical Simulation in Nursing, 24*, 25–29. https://doi.org/10.1016/j.ecns.2018.08.005

Jeffries, P. (ed.) (2007). *Simulation in nursing education*. New York: National League for Nursing.

Ker, J. (2012). Review: The challenges of developing and evaluating complex care scenarios using simulation in nurse education. *Journal of Research in Nursing, 17,* 346–347. https://doi.org/10.1177/1744987112449970

Keskitalo, T. (2015a). Designing a pedagogical model simulation-based healthcare education. Acta Universitatis Lapponiensis 299. Rovaniemi, Lapland University Press.

Keskitalo, T. (2015b). Theoretical and pedagogical underpinnings of simulation-based healthcare and medical education. In S. Carliner, C. Fulford & N. Ostashewski (Ed.), Proceedings of EdMedia: World Conference on Educational Media and Technology 2015 (pp. 1191-1199). Association for the Advancement of Computing in Education (AACE).

Keskitalo, T., Ruokamo, H. & Gaba, D. (2014). Towards Meaningful Simulationbased Learning with Medical Students and Junior Physicians. *Medical teacher, 36i(3),* 230-239. https://doi.org/10.3109/0142159X.2013.853116

Kihlgren, P., Spannagel, L., & Dieckmann, P. (2015). Investigating novice doctors' reflections in debriefings after simulation scenarios. *Medical Teacher*, *37*, 437–443. https://doi.org/ 10.3109/0142159X.2014.956054

Kirkpatrick, D. L. (1998). *Evaluating Training Programs: The Four Levels. (2nd ed.)*. Berrett-Koehler.

Kneebone, R. (2005). Evaluating clinical simulations for learning procedural skills: A theory-based approach. *Academic Medicine*, *80*(6), 549–553. https://doi.org/10.1097/00001888-200506000-00006

Knowles, M. S., Holton, E. F., & Swanson, R. A. (1998). *The adult learner.* (5th ed.). Houston, TX: Gulf Publishing Company.

Kolb, D. A. (1984). Experiential learning: Experiences as a source of learning and development. Prentice Hall.

Konia, M. & Yao, A. (2013). Simulation a new educational paradigm? *The Journal of Biomedical Research*, *27*(2), 75–80. https://doi.org/10.7555/JBR.27.20120107

Lai, A., Haligua, A., Bould, M. D., Everett, T., Gale, M., Pigford, A-A., & Boet, S. (2016). Learning crisis resource management: Practicing versus observational role in simulation training – A randomized controlled trial. *Anaesthesia Critical Care and Pain Medicine, 35*(4), 275–281. https://doi.org/10.1016/j.accpm.2015.10.010

Laksov, K. B., Nikkola, M., & Lonka, K. (2008). Does teachers' thinking match teaching practice? A study of basic science teachers. *Medical Education, 42,* 143–151. https://doi.org/10.1111/j.1365-2923.2007.02985.x

LeBlanc, V. R., & Posner, G. D. (2022). Emotions in simulation-based education: friends or foes for learning? *Advances in Simulation7*(3). https://doi.org/10.1186/s41077-021-00198-6

Leigh, G., & Steuben, F. (2018). Setting Learners up for Success: Pre-simulation and Pre-briefing Strategies. *Teaching and Learning in Nursing, 13,* 185–189. http://dx.doi.org/10.1016/j.teln.2018.03.004

Levett-Jones, T., & Lapkin, S. (2014). A systematic review of the effectiveness of simulation debriefing in health professional education. *Nurse Education Today*, *34*, 58–63. https://doi.org/10.1016/j.nedt.2013.09.020

Littlewood, K. (2011). High fidelity simulation as a research tool. *Best Practice & Research Clinical Anaesthesiology*, *25*, 473–487. https://doi.org/ 10.1016/j.bpa.2011.08.001

McCoy, E., Menchine, M., Anderson, C., Kollen, R., Langdorf, M. I., & Loftipour, S. (2011). Prospective randomized crossover study of simulation vs. didactics for teaching medical students the assessment and management of critically ill patients. *The Journal of Emergency Medicine*, *40*(4), 448–455. https://doi.org/10.1016/j.jemermed.2010.02.026

McGaghie, W. C., Draycott, T. C., Dunn, W. F., Lopez, C. M., & Stefanidis, D. (2011). Evaluating the impact of simulation on translational patient outcomes. *Simulation in Healthcare, 6*(7), 42–47. https://doi.org/10.1097/SIH.0b013e318222fde9

McGaghie, W. C., Issenberg, S. B., Cohen, E. R., Barsuk, J. H., & Wayne, D. B. (2011). Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. *Academic Medicine*, *86*(6), 706–711. https://doi.org/10.1097/ACM.0b013e318217e119

Moll-Khoswari, P., Zöllner, C., Cencin, N., & Schulte-Uentrop, L. (2021). Flipped learning enhances non-technical skill performance in simulation-based education: a randomised controlled trial. *BMC Medical Education, 21*(353). https://doi.org/10.1186/s12909-021-02766-w

Motola, I., Devine, L. A., Chung, H. S., Sullivan, J. E., & Issenberg, S. B. (2013). Simulation in healthcare education: A best evidence practical guide. AMEE Guide No. 82. *Medical Teacher*, *35*(10), 1511–1530. https://doi.org/10.3109/0142159X.2013.818632

Nguyen, N., Elliot, J. O., Watson, W. D., & Dominguez, E. (2015). Simulation improves nontechnical skills performance of residents during the perioperative and intraoperative phases of surgery. *Journal of Surgical Education*, *72*(5), 957–963. https://doi.org/10.1016/j.jsurg.2015.03.005

Norman, G., Dore, K., & Grierson, L. (2012). The minimal relationship between simulation fidelity and transfer of learning. *Medical Education*, *46*, 636–647. https://doi.org/10.1111/j.1365-2923.2012.04243.x

Nyström, S., Dahlberg, J., Edelbring, S., Hult, H., & Abrandt-Dahlgren, M. (2016). Debriefing practices in interprofessional simulation with students: A socio-material perspective. *BMC Medical Education*, *16*, 148.

Paige, J. B., & Daley, B. J. (2009). Situated cognition: A learning framework to support and guide high-fidelity simulation. *Clinical Simulation in Nursing*, *5*, 97–103. https://doi.org/10.1016/j.ecns.2009.03.120

Power, T., Virdun, C., White, H., Hayes, C., Parker, N., Kelly, M., Disler, R., & Cottle, A. (2016). Plastic with personality: Increasing student engagement with manikins. *Nurse Education Today*, *38*, 126–131. https://doi.org/10.1016/j.nedt.2015.12.001

Ramsingh, D., Alexander, B., Khanhvan, L., Williams, W., Canales, C., & Cannesson, M. (2014). Comparison of the didactic lecture with the simulation/model approach for the teaching of a novel perioperative ultrasound curriculum to anesthesiology residents. *Journal of Clinical Anaethesia*, *26*, 443–454. https://doi.org/10.1016/j.jclinane.2014.01.018

Rivière, E., Saucier, D., Lafleur, A., Lacasse, M., & Chiniara, G. (2018). Twelve tips for efficient procedural simulation. *Medical Teacher, 40*(7). 743–751. https://doi.org/10.1080/0142159X.2017.1391375

Rudolph, J. W., Simon, R., Raemer, D. B., & Eppich, W. J. (2008). Debriefing as formative assessment: Closing performance gaps in medical education. *Academic Emergency Medicine*, *15*(11), 1010–1016. https://doi.org/ 10.1111/j.1553-2712.2008.00248.x

Rystedt, H., & Sjöblom, B. (2012). Realism, authenticity, and learning in healthcare simulations: Rules of relevance and irrelevance as interactive achievements. *Instructional Science*, *40*, 785–798. https://doi.org/10.1007/s11251-012-9213-x

Schroedl, C. J., Corbridge, T. C., Cohen, E. R., Fakhran, S. S., Schimmel, D., McGaghie, W. C., & Wayne, D. B. (2012). Use of simulation-based education to improve resident learning and patient care in the medical intensive care unit: a randomized trial. *Journal of Critical Care*, *27*, e7–e13. https://doi.org/ 10.1016/j.jcrc.2011.08.006

Solnick, A., & Weiss, S. (2007). High fidelity simulation in nursing education: A review of the literature. *Clinical Simulation in Nursing Education*, *3*, 41–45. https://doi.org/10.1016/j.ecns.2009.05.039

Steinwachs, B. (1992). How to facilitate debriefing. S*imulation & Gaming*, *23*(2), 186–192. https://doi.org/10.1177/1046878192232006

Swamy, M., Bloomfield, T. C., Thomas, R. H., Singh, H., & Searle, R. F. (2013). Role of SimMan in teaching clinical skills to preclinical medical students. *BMC Medical Education*, *13*(20). https://doi.org/10.1186/1472-6920-13-20

Tremblay, M-L., Leppink, J., Leclerc, G., Rethans, J-J., & Dolmans, D. H. J. M. (2019). Simulation-based education for novices: complex learning tasks promote reflective practice. *Medical Education, 53,* 380–389. https://doi.org/ 10.1111/medu.13748

Tutticci, N., Ryan, M., Coyer, F., & Lewis, P. (2018). Collaborative facilitation of debrief after high-fidelity simulation and its implications for reflective thinking: student experiences. *Studies in Higher Education, 43*(9), 1654–1667. https://doi.org/10.1080/03075079.2017.1281238

Van Soeren, M., Devlin-Cop, S., MacMillan, K., Baker, L., Egan-Lee, E., & Reeves, S. (2011). Simulated interprofessional education: An analysis of teaching and learning processes. *Journal of Interprofessional Care*, *25*(6), 434–440. https://doi.org/10.3109/13561820.2011.592229

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes.* Harvard University Press.

Walton, J., Chute, E., & Ball, L. (2011). Negotiating the role of the professional nurse: The pedagogy of simulation: A grounded theory study. *Journal of Professional Nursing*, *27*(5), 299–310. https://doi.org/10.1016/j.profnurs.2011.04.005

Wang, E. E. (2011). Simulation and adult learning. *Disease a Month*, *57*, 664–678. https://doi.org/10.1016/j.disamonth.2011.08.017

Weller, J. M. (2004). Simulation in undergraduate medical education: Bridging the gap between theory and practice. *Medical Education*, *38*, 32–38. https://doi.org/10.1111/j.1365-2923.2004.01739.x

Yue, Y. L., Mio, L. A., Wai, I. N., & Si C. W. (2022). High-fidelity simulation in undergraduate nursing education: A meta-analysis. *Nurse Education Today, 111.* https://doi.org/10.1016/j.nedt.2022.105291.

Zigmont, J. J., Kappus, L. J., & Sudikoff, S. N. (2011). Theoretical foundations of learning through simulation. *Seminars in Perinatology*, *35*, 47–51. https://doi.org/10.1053/j.semperi.2011.01.002

Ziv, A., Small, S. D., & Wolpe, P. R. (2000). Patient safety and simulation-based medical education. *Medical Teacher*, *22*(5), 489–495. https://doi.org/10.1080/01421590050110777

Appendix 1. List of all included articles

Study and method	Participants / Data	Aim	Outcome
1. Alinier, G. (2011): Theoretical	–	Prepare a practical guide for developing high-fidelity simulation scenarios	A practical guide for simulation facilitators
2. Ahmed et al. (2012): Qualitative interview study	33 healthcare professionals	Identify best practice guidelines for effective debriefing	Best practices for debriefing
3. Andreatta et al. (2010): Mixed method	27 preclinical medical students	To study learners' stress reaction during simulation-based laparoscopic training	Stress reactions can be induced in SBLE
4. Arthur et al. (2013): Qualitative Delphi study	32 international experts	To identify quality indicators for the design and implementation of simulation	Study results 15 quality indicator statements
5. Aura et al. (2016): Qualitative interview study	16 diagnostic radiographers	The aims of this study were to explore and define radiographers' competence in intravenous pharmacotherapy before and after a simulation-based education and to examine radiographers' perceptions of the transfer of learning into clinical practice	Provide information on the pedagogical practices and explain the learning theoretical background of the intervention (Kolb's experiential learning cycle)
6. Bearman et al. (2019): Qualitative study	5053 participants from a faculty development program	The aim of the study was to seek powerful SBE experiences and through this to understand in what ways SBE may influence learning	Provide understanding on the scenario phase of SBE
7. Beauchesne & Douglas (2011): Theoretical	–	To describe the creation of a simulation learning experience	Provide some guidelines for the simulation facilitator
8. Berragan (2014): Qualitative mixed method study	students (n = 9), nurse educators (n = 3), and nurse mentors (n = 4)	To explore the experiences of nursing students while participating in the simulation	To formulate an expansive model of learning
9. Bland & Tobbell (2016): Qualitative mixed method study	46 final year study	To study attributes that enable student learning in SBLE	This study offers a theoretical basis for understanding simulation-based education
10. Boese et al. (2013): Theoretical	–	To illustrate the standards for a competent facilitator	Best practices for the facilitator
11. Boet et al. (2014): Theoretical	–	To provide educational and pedagogical tips for the simulation facilitator	Provide facilitators with 12 practical and pedagogical tips for SBE

12. Brewer (2011): Review	10 articles	To explore techniques used successfully in simulation-based nursing education	Simulation is a valuable tool, but there is need for discovering how to facilitate it
13. Cant & Cooper (2009): Review	12 articles	To compare simulations with other educational strategies	Simulation is an effective method of teaching and learning
14. Chen et al. (2015): Quantitative study	60 nursing students	To compare low- and high-fidelity simulations	There were no significant differences in performance between low and high-fidelity; describe the pedagogical activities of participants
15. Cheng et al. (2014): Review	177 articles	To evaluate the effectiveness of debriefing	There is no clear evidence of the type of simulation that leads to effective learning. Debriefing characteristics were noticed to be incompletely reported
16. Chiniara et al. (2013): Theoretical	–	To provide a taxonomy for the instructional design of healthcare simulation	Produced instructional framework
17. Cook et al. (2013): Review	289 articles	Evaluate the effectiveness of instructional design features	The several instructional design features are effective
18. Craft et al. (2014): Quantitative study	32 nursing student	To compare two instructional methods	Guided experiential learning is more effective
19. Decker et al. (2013): Review	–	Best practices for the facilitation of debriefing	Tips for debriefing
20. DeMaria et al. (2010): Mixed method quantitative study	25 medical students	To study the effects of anxiety on learning	Added emotional stressors led to greater anxiety, but enhanced learning
21. Der Sahakian et al. (2015): Theoretical	–	To set conditions for productive debriefing	Six principles for productive debriefing
22. Dieckmann et al. (2012): Qualitative interview study	7 simulation educators	To describe goals and success factors for and barriers to optimizing the simulation-based learning environments	The functional use of simulations depends on the humans involved, the equipment they use, and the organizational framework
23. Dieckmann et al. (2009): Mixed method	89 simulation center leaders and participants of simulation exercise	Describe the practice of debriefing	The practice of debriefing might, at times, differ from the ideal

24. Dieckmann (2009): Theoretical	–	To understand the structure of simulation-based education	To illustrate the simulation setting model
25. Dismukes et al. (2006): Editorial	–	The aim is to provide understanding on the facilitated debriefing	Illustrates the role of the facilitator and learners in debriefing
26. Dreifuerst (2012): Quantitative quasi-experimental study	238 nursing students	To study the effectiveness of the Debriefing for Meaningful Learning method for clinical reasoning skills	DML is an effective debriefing method. Provide understanding on the best practices of debriefing.
27. Dufrene & Young (2014): Review	13 articles	To review the usefulness of debriefing strategies and study participants' perceptions of debriefing	There is no clear evidence which debriefing methods is the best, although feedback accompanying learning is beneficial
28. Fanning & Gaba (2007): Review	–	The aim of the paper is to critically review what is felt to be important about the role of debriefing in the field of simulation-based learning	Illustrates many models and strategies for effective debriefing
29. Fenwick & Dahlgren (2015): Theoretical	–	The aim is to present a sociomaterial perspective on simulation-based education	Provide understanding on the planning of the case scenario
30. Garden et al. (2015): Review	8 articles	To study the effectiveness of debriefing methods	Generally, performance was improved after skilled debriefing
31. Gardner (2013): Theoretical	–	The aim is to introduce the essential topics related to debriefing	Many pedagogical principles for debriefing
32. Garrett et al. (2011): Mixed method	30 senior nursing students	To explore the experiences of using HFS in Canada	Provide understanding on the students` experiences in simulation
33. Gibbs (2014): Qualitative interview study	12 sonography students	To study the experiences of students	Provide some insights to pedagogical practices in SBE
34. Goldberg et al. (2015): Quantitative study	24 first-year residents	Studying the effects of self-directed learning and patient's death on learning	Allowing residents to practice independently in the simulation, and subsequently, allowing them to fail, can be an important part of simulation-based learning.
35. Ha (2014): Quantitative study	44 nursing students	To identify attitudes towards video-assisted debriefing	Provide insights on debriefing

36. **Horsley & Wambach (2015): Quantitative study**	91 junior lever nursing students	The purpose of this study was to determine the effect of the presence of nursing faculty on students' levels of anxiety, self-confidence, and clinical performance	There was no difference if faculty was present
37. **Hunt et al. (2014): Quantitative study**	70 paediatric residents	To study if performance improves after a rapid cycle of deliberate practice	Pediatric residents' skills improved after rapid cycle of deliberate practice
38. **INACSL (2016): Theoretical**	–	To illustrate standards for the facilitation process	Standards for facilitation before, during, and after the simulation scenario
39. **INACSL (2021): Theoretical**	-	To illustrate standards for the simulation design process	Provides a framework for developing effective simulation-based experiences for participants
40. **Issenberg (2006): Editorial**	–	To emphasize that in the future, we must focus on the most effective use of simulation for healthcare education	Provide understanding on the role of the facilitator
41. **Issenberg et al. (2005): Review**	109 articles	To find out the features and uses of simulation that lead to effective learning	There are 10 features in simulation-based medical education that facilitate learning
42. **Jarvill & Krebs (2018): Quantitative**	68 undergraduate nursing students	Purpose is to study the use of an expert role modeling video during pre-briefing in simulation	Complete our current understanding on the best practices if prebriefing
43. **Jaye et al. (2015): Theoretical**	–	The aim of the article is to present the diamond structure for debriefing	Provide ideas for debriefing
44. **Keskitalo et al. (2014): Qualitative study**	9 facilitators, 25 medical students and residents	To investigate the meaningfulness of simulation-based learning	The simulation-based learning is inherently meaningful
45. **Kihlgren et al. (2015): Qualitative study**	38 debriefings, 10 debriefer	To investigate the reflection level in debriefings	Participants reflection were low level
46. **Kneebone et al. (2007): Theoretical**	–	This paper argues for a structured approach to procedural skills training	Offer principal components for simulation-based learning and its evaluation
47. **Lai et al. (2016): Quantitative study**	39 emergency medicine residents	To compare active participation and observer participant in simulation followed by a debriefing	Active participation is not necessarily required; debriefing seems to be important

48.	**LeBlanc, & Posner (2022): Theoretical**	-	The purpose of the article is to present a narrative overview of the research on emotions, cognitive processes and learning within simulation	Provides strategies to mindfully consider emotions during SBE
49.	**Leigh & Steuben (2018): Review**	11 articles	Purpose of the study is to discuss the components of a superior pre-briefing phase and provide practical suggestions for educators when designing pre-simulation assignments	Provide practical tips for pre-briefing phase
50.	**Levett-Jones & Lapkin (2014): review**	10 articles	The aim of the study was to explore the effectiveness of debriefing methods	No debriefing method is better than any other
51.	**Li et al. (2011): Quantitative**	30 medical students	To investigate whether pre-training evaluation and feedback aid student learning	Pre-training evaluation and feedback were beneficial for students' learning
52.	**Littlewood (2011): Review**	–	The aim is to review the current terminology, current practice, and current research in simulation	
53.	**McGaghie et al. (2010): Qualitative review**	–	To review historical and contemporary research on SBME	12 features of best practices that lead to effective learning within simulation
54.	**Mills et al. (2016): Quantitative study**	70 nursing students	To investigate whether more people in SLE increase their stress and anxiety	Greater amount of people during simulation increase anxiety and result poorer performance
55.	**Moll- Khosrawi et la., (2021): Quantitative study**	102 3rd year medical students	Study aimed to analyze, whether flipped learning improved students´ non-technical skills (NTS) performance compared to lecture-based learning (LBL)	Pre-learning affect learners' performance.
56.	**Motola et al. (2013): Review**	–	This guide focuses on educational principles that lead to effective learning	The guide includes many topics important for simulation-based education, e.g., feedback and debriefing, deliberate practice, and curriculum integration
57.	**Neill et al. (2011): Review**	9 articles	The aim of this review is to analyze the literature on the use of simulation debriefing in nursing education	There is no consensus for effective debriefing, however, it is central strategy for SBL
58.	**Norman et al. (2012): Review**	24 articles	To compare High-fidelity simulation and low-fidelity simulation	Both simulations resulted improvements in learning, however,

				no significant advantages was found when used HFS
59.	**Nyström et al. (2016): Qualitative**	106 nursing and medical students	To study debriefing as a socio-material practice	Debriefing practice is relational to social and material arrangements, and debriefing as laissez-faire seems to be more learner-centered.
60.	**Paige et al. (2015): Theoretical**	–	One aim of the paper is to demonstrate how to debrief effectively	Key elements for educators to keep in mind include: approach, learning environment, engagement of learners, reactions, reflection, analysis, diagnosis, and application
61.	**Parmar & Delaney (2011): theoretical**	–	To discuss the experience with different skills simulators	The more proximate the feedback, the better its effectiveness
62.	**Paskins & Peile (2010): thematic analysis of focus group**	28 final year medical students	To explore in depth the features of simulation-based education that lead to effective learning	Medical students value the simulation-based learning, but the effect of simulation on confidence, anxiety, and self-efficacy is more problematic
63.	**Power et al. (2016): Qualitative study**	9 students	How to enhance students' engagement with mannequins	Stories (pre-briefing) can facilitate students' engagement emotionally with the manikin
64.	**Rivière et al. (2018): Theoretical**	-	The aim of the article is to provide theory-informed practical strategies for procedural simulation	Article presents 12 practical tips for efficient procedural simulation
65.	**Rudolph et al. (2006): Theoretical**	–	To present the feedback method "debriefing with good judgment"	The technique is designate to increase the mutual respect and that the trainee hears and processes what the instructor is saying without being defensive or trying to guess the critical judgment
66.	**Rudolph et al. (2007): Theoretical**	–	This article offers an approach called "debriefing with good judgment"	-//-
67.	**Rudolph et al (2008): Theoretical**	-	The authors present a four-step model of debriefing	The proposed model help to close the performance gap.

68. Rystedt, & Sjöblom (2012): interaction analysis of video data	Healthcare personnel	To explore the requirements needed to establish and maintain simulation as an authentic representation of clinical practice	The realism of the simulation is maintained through the participants' mutual orientation to the moral order of good clinical practice and a proper simulation. -> learning to simulate
69. Saylor et al. (2015); Quantitative	11 experts	To develop an instrument to assess a debriefer's excellence	To provide instruments and some practices for debriefing
70. Shanks et al. (2010): Quantitative	106 internal medicine residents	To study how simulators should be used in a procedural curriculum	Residents value simulation-based education in the form of small group sessions
71. Shinnick & Woo (2015): quantitative	161 nursing students	To investigate students' learning styles and learning with HFS	The HFS support learning despite the different learning styles
72. Sorensen et al. (2017): Qualitative	25 healthcare professionals	To examine off-site and in-situ learning experiences	In situ simulation had more organizational impact and provided more information for practical organizational changes than off-site simulation
73. Spence et al. (2016): Quantitative	138 medical students	The study aimed to evaluate the effectiveness of video compared to verbal feedback	Use of video feedback when teaching cardiopulmonary resuscitation is more effective than verbal feedback, and enhances skill retention
74. Treadwell & Grobler (2001): Qualitative	196 medical students	To study students' experiences of practical skills' training in a simulation-based learning environment	SBL enhanced learning. Students gave many recommendations for SBE
75. Tremblay et al. (2019): Mixed methods	167 2nd year pharmacy students	The purpose of this study was to understand the effects of task complexity on undergraduate pharmacy students' cognitive load, task performance and perception of learning in SCI	Provide understanding on the case scenario design
76. Tutticci et al. (2018): Qualitative study	654 students, 55 debriefing observation	Purpose of the study was to inquiry about collaborative debriefing and its implication for students' reflective thinking	Provide further understanding on the debriefing phase
77. Udani et al. (2014): Quantitative	21 anesthesia residents	The paper determines if adding simulation-based deliberate practice to a base curriculum	SBE added to base curriculum improves anesthesia residents' performance. Explained

			improved the performance of a subarachnoid block	the pedagogical model used
78.	**Van Soeren et al. (2011): Qualitative**	152 clinicians	To explore simulation-based teaching and learning processes	The study illustrated aspects that need careful attention: enthusiasm and motivation; professional role assignment: scenario realism; facilitator style and background; team facilitation
79.	**Walton et al. (2011): qualitative**	26 nursing students	To understand how students learn with simulation and to identify basic social processes and supportive teaching strategies	Conceptual model of socialization process was to develop to assist faculty in understanding students' learning
80.	**Wiseman & Horton (2011): Qualitative**	–	The paper aims to describe an international experience of developing simulated learning with students	Students' experiences can be effectively used to develop simulated learning experiences
81.	**Woolley & Jarvis (2007): Theoretical**	–	To present a pedagogical model for teaching and learning clinical skills	To present model that draws from the principles of cognitive apprenticeship
82.	**Zigmont et al. (2011): Theoretical**	–	To design a framework for facilitators of debriefing	Paper offers a 3D model: Defusing, Discovering, Deepening for debriefing
83.	**Østergaard et al. (2007): Theoretical**	–	To describe a framework for a team training course	Example of the development of the team training course (needs assessment, learning objective, educational methods and tools (adult learning principles) etc.)