High-Fidelity Simulation Pre-Briefing with Digital Quizzes: Using INACSL Standards for Improving Effectiveness

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Abstract: High-fidelity simulations enable medical students to gain experience in typical scenarios through the use of computerized manikins, though their learning outcomes and performance greatly depend on their preparation. To that end, a pre-briefing phase is typically set up to teach the students the necessary information, including both the theory and the technical workings of the manikin. Our work explores a digital-first approach to pre-briefing, where the learners are provided quizzes through a mobile application, which allows them to identify gaps in their knowledge and reinforce their retention through repetitive testing in their own time. Additionally, demonstrative videos of the manikin are offered to complement their learning. The quiz-based approach to pre-briefing has been tested with a university class of medical students to prepare them for a basic life support simulation. We discuss our findings in terms of how the digital quizzes were perceived by students and evaluate our pre-briefing method against a set of best practices established by "The International Nursing Association for Clinical Simulation and Learning" (INACSL). Finally, recommendations to improve the quiz-based approach are outlined for future case studies.

1 INTRODUCTION

Lack of practice is a common complaint in medical education, but simulation is increasingly employed as a novel approach to address this concern. Research has shown that simulation-based education improves skill performance, knowledge, and patient outcomes (Zeng et al., 2023). High-fidelity patient simulation is an advanced teaching method that utilizes a computerized manikin to simulate real-life scenarios. It helps students integrate their knowledge and skills based on their clinical decisions. It has also been used for problem-solving and clinical reasoning abilities in educational training (Wong et al., 2023).

High-fidelity simulation involves three phases, referred to by different terms in various sources, such as pre-briefing, simulation, and debriefing (Tong et al., 2022a). Alternatively, they may be defined as preparation, participation and debriefing, with preparation being composed of a pre-briefing and a briefing (Tong et al., 2022b). In some contexts, the three stages are pre-briefing, clinical case scenarios, and debriefing (Duque et al., 2023).

This research solely focuses on the initial "pre-briefing" phase, which refers to "the activities PRIOR to the start of the simulation including the preparation and briefing aspects" according to "The International Nursing Association for Clinical Simulation and Learning" (INACSL) definition (McDermott et al., 2021). Students expect to develop their skills during the simulation, but the class time dedicated to the simulation can be limited. As the students need to be adequately prepared for these time-constrained simulations, the pre-briefing can equip them with the necessary knowledge to successfully perform the simulation (Tong et al., 2022b). While the debriefing phase has been widely studied and practiced, the significance of pre-briefing has recently been highlighted in studies by showing that its combination with the participation and debriefing phases helps students "anticipate priorities, recognize and respond to changes in the condition, and reflect on prioritization choices" (Penn et al., 2023).

Traditionally, preparation for simulations involved conventional methods such as lectures, textbook readings, and skills practice. Newly, alternative strategies involve web-based modules, mental rehearsal, and the development of cognitive aids or care plans. Furthermore, facilitating self-assessment through quizzes, self-reflections, or competency rubrics may allow learners to identify knowledge or skill gaps before engaging in simulations and to foster self-regulated learning (Tyerman et al., 2019).

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Recent studies and reviews (Silva et al., 2022; Tyerman et al., 2019) have highlighted alternative methods that have been used either alone or in combination with traditional methods. These include video-based resources for pretraining, such as healthcare professionals role modeling patient care, informative reviews of concepts, and demonstrations of scenarios developed by expert nurses in the role modeling capacity. Other resources include web-based guides, discussion forums, team building and communication exercises, and so on. In particular, the INACSL also recommends some preparation activities such as: "Assigned readings or audiovisual materials, Review of the patient health record/patient report, Observation of a model of a simulated case, Completion of a pretest or quiz (McDermott et al., 2021)."

Implementing a pre-briefing session through videotaping has been shown to be effective (Wheeler and Kuehn, 2023). Moreover, quizzes containing higher-order thinking questions can be an effective tool to prepare learners for simulation-based learning experiences, as they can prompt critical thinking and motivate students to study relevant literature for the answers. In this context, simulation experts may set a minimum threshold on the score to obtain on the pre-quizzes such that the students are eligible to partake in the corresponding simulations (Leigh and Steuben, 2018).

The goal of practice through quizzes is to invoke a testing effect (Roediger III and Karpicke, 2006; Fernandez and Jamet, 2017; Van Gog and Sweller, 2015), which has been shown to improve the long-term retention of students compared to the act of restudying (Eisenkraemer et al., 2013). Additionally, the indirect effects of testing can further help the student with their learning: firstly, they can apply their theoretical knowledge to questions and consequently assess their current understanding without the aid of a teacher, which has been shown to also break their false, confident perception that they already master the topics without practice. Secondly, they can improve their future restudying efforts (Arnold and McDermott, 2013; Izawa, 1971) by knowing which select topics to focus on.

The testing effect is also dependent on several factors which determine its efficacy. Firstly, harder questions require a greater retrieval effort by the student, which in turn can improve the resulting testing effect (Greving and Richter, 2018; Rowland, 2014). One approach is to rely on free-form (recall) questions (Eisenkraemer et al., 2013; Greving and Richter, 2018; Van Gog and Sweller, 2015; Cranney et al., 2009), which are considered harder than multiple-choice questions due to the latter's passive recognition nature, i.e., simply having to recognize the correct answer as opposed to remembering and producing it from memory.

Next, testing needs to be performed regularly (Eisenkraemer et al., 2013; Cranney et al., 2009), as the student's retention can decay overtime. Lastly, students may also retain incorrect information and weaken their retention when they answer questions wrongly (Eisenkraemer et al., 2013; Cranney et al., 2009; Greving and Richter, 2018). To counteract this negative testing effect (Richland et al., 2009; Arnold and McDermott, 2013; Barber et al., 2011; Butler and Winne, 1995; Eisenkraemer et al., 2013; Cranney et al., 2009; Van Gog and Sweller, 2015; Roediger III and Karpicke, 2006; Fernandez and Jamet, 2017), it is important to provide immediate feedback to the learner by not only informing them of the correct answer but also by providing an explanation such that they understand why they had originally answered incorrectly. Feedback can thus not only prevent a negative testing effect, but even further reinforce the student's learning and retention (Hattie and Timperley, 2007; Azevedo and Bernard, 1995).

The remainder of this paper is organized as follows. In Section 2, we lay out the objectives of our case study and highlight our methodology in Section 3. Next, we describe the results in Section 4 and discuss our findings alongside recommendations in Section 5. We conclude in Section 6 with the future work planned for our next case study.

2 OBJECTIVES

The literature generally lacks guidance on the proper organization of simulation pre-briefings, with no consistent approach to implementation. It is recommended that researchers focus on pre-briefing to help close those gaps (Wheeler and Kuehn, 2023).

A recent study (Sheykhmohammadi et al., 2023) formulated recommendations for improving high-fidelity simulation sessions using manikins in a university setting, which were based on the challenges and requirements faced by both the students and trainers. These include:

1. Scenario design and implementation
2. Before simulation (Pre-briefing)
3. During simulation
4. After simulation (Debriefing and feedback)

The necessary steps and frameworks for developing valid and reliable scenarios were outlined for the given manikin's software. Given these findings, our

research focuses on reforming the pre-briefing by relying on purely digital means. In particular, we explore digital quizzes to prepare students for a specific simulation scenario, which are intended to test their knowledge such that they can identify gaps they need to study up on further, as well as to reinforce their retention through repetition of the quizzes.

The goal is to facilitate access to self-regulated testing by providing the quizzes through a mobile application which they can use in their own time, thus allowing them to align their testing with their personal study schedule. Additionally, while the quizzes are intended to include questions both about the theory behind the upcoming simulation scenario, as well as technical information such as how to work with the manikin, the pre-briefing also relies on recorded videos demonstrating the manikin's functionality.

By applying our pre-briefing method to a university class of students who were preparing for a high-fidelity simulation, we aim to gauge both their interest and motivation in using our approach, as well as its effect on their simulation performance.

3 METHOD

According to McDermott et al, Pre-briefing activities are designed to provide a "psychologically safe learning environment" for the simulation-based experience through two key components (McDermott et al., 2021):

1. Preparation: the learners are aligned with a common mental model.
2. Briefing: the learners are conveyed essential ground rules.

To that end, we relied on video-based resources and digital quizzes to realize our pre-briefing approach.

Firstly, we chose the mobile quiz app BEACON Q due to several features which can help the students achieve an effective testing effect to improve both their studying efforts and their retention: educators can schedule quizzes for specific periods, which allows each student to align their testing with their personal study timing before the simulation session.

It also supports replaying quizzes, which enables the learner to regularly practice and reinforce their retention. Furthermore, BEACON Q adjusts the difficulty of questions to each user's performance level, e.g., by changing the format of multiple-choice questions to free-form, with the latter potentially resulting in a stronger testing effect.

Finally, the application provides immediate feedback to the user, who not only has their answer evaluated, but who is also given explanations to further describe the question and its possible answers, including the distractors (wrong answers), which also helps avoid a negative testing effect.

BEACON Q can thus cover the quizzing portion of the pre-briefing. In particular, the dynamic adjustment of the quizzes' difficulty is important, given the best practice criterion "The experience and knowledge level of the simulation learner should be considered when planning the pre-briefing." (Miller et al., 2021). BEACON Q accommodates the simulation learner's knowledge level over time as they replay quizzes by collecting their performance data and either rendering the same questions easier or harder depending on their past attempts.

To test our method of pre-briefing, we selected third-year medical students at a university to conduct a simulation session based on the BLS scenario, using a high-fidelity manikin manufactured by MedVision[1].

For the preparation phase, an initial quiz was provided through the BEACON Q app, with 13 questions prepared based on research (Spinelli et al., 2021) and the advice of a professional anesthesiologist who also acted as the simulation teacher. The questions covered both theoretical and guideline-based knowledge about the BLS scenario. To introduce the students to the BEACON Q app, an explanatory session was organized two weeks before the planned simulation, after which they gained access to the quiz. Each student was free to play the quiz on their given day and time until the simulation session.

Next, for the briefing phase, we relied on a second digital quiz which was prepared by the simulation teacher and a high-fidelity simulation expert. The quiz contained 11 questions covering the manikin's functionality, though several demonstrative videos were also provided to the students through both the second quiz, as well as their learning management system Moodle. The second quiz became available to play slightly later, specifically six days before the simulation session. Playing both quizzes was a prerequisite to participating in the simulation session. Following the pre-briefing and the simulation, we analyzed the quiz results, questionnaire responses and simulation performance of the students. Based on our findings and in accordance with the INACSL (McDermott et al., 2021) standards, we endeavored to formulate recommendations for optimizing the incorporation of video and quiz-based training to enhance our pre-briefing process.

[1]Manikin "Leonardo" by MedVision Group: https://www.medvisiongroup.com/leonardo.html

4 RESULTS

We present the results of the students' performance on the digital quizzes, followed by their questionnaire responses.

4.1 Quizzes

Two quizzes were playable through the mobile quiz app BEACON. The first quiz meant for the preparation step of the pre-briefing was available from 26 October to 2 November and contained 13 questions. Each student could initiate their quiz attempt at any time during that period, but they would be limited to 30 minutes to finish it once started. The average success rate for this quiz was 85%, i.e., 85% of all students' answers to the 13 unique questions were correct. However, only 15% of the answers were followed by feedback reviews, meaning instances where a student would tap on a given choice, either correct or a distractor, after submitting their answer to read the additional explanations provided by their simulation teacher.

Next, the second quiz meant for the briefing step of the pre-briefing was available from 2 November to 6 November and contained 11 questions, with the quiz expiring shortly before the simulation session. The students were granted more time to finish the second quiz once started, specifically 50 minutes, due to some of its questions requiring them to watch videos before answering. Similar to the first quiz, the success rate was high at 83%, though in this case there were no feedback reviews whatsoever.

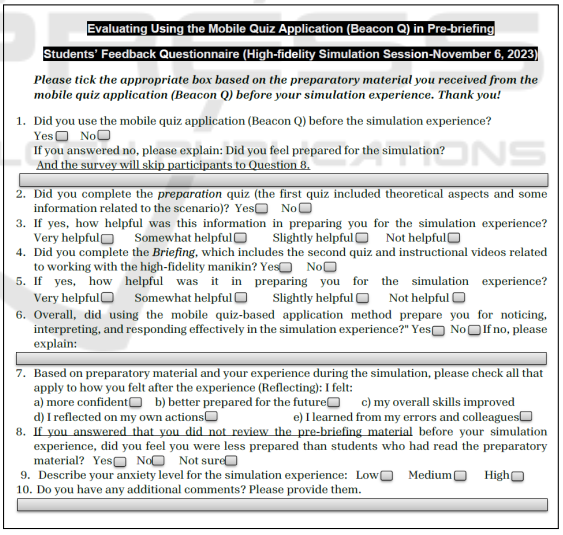
As a final note, the days on which the students played each quiz were spread out, especially in the second quiz' case. However, the first quiz was played more often on either the first day or the day after it became available, and no students played it over the weekend. On the other hand, the second quiz was also played over the weekend, most likely due to the simulation being on the following Monday.

4.2 Questionnaire

After the simulation session, students were invited to fill out a questionnaire, shown in Figure 1, to capture their impressions of the BEACON Q quiz app, as well as how prepared they felt for the simulation. The questions were primarily designed based on expert insights along with past research (Sharoff, 2015).

The average student answers to the choice-based questions $1-9$ are given in Table 1, which firstly indicates that 89.66% of the 29 students had used the BEACON Q app. Next, 86.21% of the students had played the preparation quiz, with only 55.17% finding it helpful in preparing them for the simulation. Furthermore, the briefing quiz, which included instructional videos in its questions, was completed by 82.76% of the students, though only 31.03% found it useful. In the same context, their learning management system Moodle revealed that only 7 students had viewed the instructional videos which were made available outside of the mobile quiz app.

As for the students' impression of our quiz-based pre-briefing approach for improving how they notice, interpret and respond during the simulation session, 50.00% found it helpful. Regarding what they had taken away from both the pre-briefing and the simulation session itself, 20.69% thought they were better prepared for the future, while 15.52% felt more confident in themselves. Only 6.90% thought their skills had improved simulation, while 29.31% believed that they had gained the opportunity to reflect on their actions. Additionally, 25.86% of the participants thought they had learned lessons from both their own errors, as well as from their colleagues during the simulation. Lastly, there were no students who felt highly anxious about the simulation, with most having low levels of anxiety.



Evaluating Using the Mobile Quiz Application (Beacon Q) in Pre-briefing

Students' Feedback Questionnaire (High-fidelity Simulation Session-November 6, 2023)

Please tick the appropriate box based on the preparatory material you received from the mobile quiz application (Beacon Q) before your simulation experience. Thank you!

1. Did you use the mobile quiz application (Beacon Q) before the simulation experience? Yes ☐ No ☐
   If you answered no, please explain: Did you feel prepared for the simulation? And the survey will skip participants to Question 8.
2. Did you complete the ***preparation*** quiz (the first quiz included theoretical aspects and some information related to the scenario)? Yes ☐ No ☐
3. If yes, how helpful was this information in preparing you for the simulation experience? Very helpful ☐ Somewhat helpful ☐ Slightly helpful ☐ Not helpful ☐
4. Did you complete the ***Briefing***, which includes the second quiz and instructional videos related to working with the high-fidelity manikin? Yes ☐ No ☐
5. If yes, how helpful was it in preparing you for the simulation experience? Very helpful ☐ Somewhat helpful ☐ Slightly helpful ☐ Not helpful ☐
6. Overall, did using the mobile quiz-based application method prepare you for noticing, interpreting, and responding effectively in the simulation experience?" Yes ☐ No ☐ If no, please explain:
7. Based on preparatory material and your experience during the simulation, please check all that apply to how you felt after the experience (Reflecting): I felt:
   a) more confident ☐ b) better prepared for the future ☐ c) my overall skills improved
   d) I reflected on my own actions ☐ e) I learned from my errors and colleagues ☐
8. If you answered that you did not review the pre-briefing material before your simulation experience, did you feel you were less prepared than students who had read the preparatory material? Yes ☐ No ☐ Not sure ☐
9. Describe your anxiety level for the simulation experience: Low ☐ Medium ☐ High ☐
10. Do you have any additional comments? Please provide them.

Figure 1: Post-simulation questionnaire.

Regarding the last, free-form question of the questionnaire, 18 students had provided additional comments, with 6 of them expressing that the quizzes were not helpful, with comments such as "I do not think the quizzes were helpful in preparing us for the simulation". Their main concerns were about the content of the quizzes, though 1 student strongly opposed the mandatory nature of the pre-briefing quizzes.

Next, 5 students suggested that the quizzes could be beneficial if the quality of the content, pictures and

Table 1: Post-simulation questionnaire results for the choice-based questions.

Question Title	Results
1. Mobile Quiz App Usage	89.66%
2. Completion of Preparation Quiz	86.21%
3. Helpfulness of Preparation Quiz	Very helpful and Somewhat helpful: 55.17% Slightly helpful and Not helpful: 44.83%
4. Completion of Briefing with Instructional Videos	82.76%
5. Helpfulness of Briefing for Simulation Preparation	Very helpful and Somewhat helpful: 31.03% Slightly helpful and Not helpful: 68.97%
6. Overall Effectiveness of Quiz-Based Pre-Briefing	50.00%
7. Feelings After Simulation (Reflecting)	More confident: 15.52%, Better prepared: 20.69%, Overall skills improved: 6.90%, Reflected on own actions: 29.31%, Learned from errors and colleagues: 25.86%
8. If did not review preparatory material	Yes: 0.00%, No: 50.00%, Not sure: 50.00%
9. Anxiety Level for Simulation Experience (No Review) Anxiety Level for Simulation Experience (Review)	Low: 100.00%, Medium: 0.00%, High: 0.00% Low: 55.17%, Medium: 37.93%, High: 6.90%

videos were improved. For instance, one student mentioned ”Clearer instructions, the photos taken for the quiz on the mobile app were not taken optimally”. On the other hand, 2 students found the quizzes helpful, with one noting ”The pre-briefing quiz and the videos were very helpful for today; I felt prepared before the simulation [...]”.

Finally, 5 students mentioned that they would like to have a debriefing session, although this is beyond the scope of this research and questionnaire. For example, one student commented ”Immediate feedback will be great, so we can know what we did wrong.”, i.e., they wanted their simulation teacher or an expert to be present such that they could immediately give the students individual feedback after the simulation.

5 DISCUSSION

Following our initial case study, we discuss recommendations for organizing a pre-briefing phase based on our own quiz-based approach. Afterwards, we evaluate our method against the INACSL standards (McDermott et al., 2021).

5.1 Recommendations

For our quiz-based method of pre-briefing, some key areas can benefit from enhancements.

Primarily, there is the impression that the two quizzes which were offered as part of the pre-briefing did not cover enough content-wise: the students' success rate for them was significantly high ($> 80\%$) and in the questionnaires, they had not only noted that the quizzes were not particularly helpful in preparing them for the simulation, but some of the additional comments explicitly stated that the quizzes did not cover enough and that they were too simple. This is a point which can easily be amended, as the students did not necessarily have qualms with the mobile quiz app itself, but rather the content of the quizzes. Hence, the pre-briefing quizzes should be extended with additional questions to go into more depth when it comes to both the theory of the simulation scenario, as well as the technical know-how required for interacting with the manikin.

Furthermore, greater care should be taken when preparing the demonstrative pictures and videos of the manikin to be included both in the quizzes and on their learning management system, such as paying attention to the angle and lighting.

Next, it is important that the students also master essential skills such as team-based communication (Livne, 2019), with the latter's lack being noted while observing the students trying to work together to operate the manikin. For example, these team-based skills would include how to efficiently distribute the tasks among the group members, as well as assigning a leader at the start of the simulation to ensure someone is managing the team as a whole and keeping track of the required steps and guidelines.

Lastly, certain students opposed the fact that the digital quizzes were considered prerequisites to participating in the simulation session. We similarly believe this to not be the right approach, as the quizzes should be offered as an additional learning aid, i.e., the students themselves should be free to plan their preparation for the simulation based on all the resources we provide them during the pre-briefing.

The reason for a less restrictive approach is that intrinsic motivation (Cranney et al., 2009; Rodrigues et al., 2021) to test yourself can reinforce the testing effect, as opposed to extrinsic motivation, e.g., where the teacher forces their students to test themselves through quizzes. The purpose of testing is to improve the student's long-term retention and to enhance their future restudying efforts, not to actually teach them the material. Rather, it is important that the students still study in addition to testing themselves.

As a result, we propose that the pre-briefing should not be mainly based on quizzes, but rather on a set of resources, such as written guides and demonstrative videos, which the students would firstly study before moving on to the quizzes to practice their knowledge. This would form a loop, where the students would go back and forth between studying their material and testing what they have retained through

the quizzes until they feel confident enough in being prepared for the simulation.

5.2 INACSL Standards

INACSL has established a set of standards for simulation under the title ”Healthcare Simulation Standards of Best Practice” (HSSOBP), which cover aspects such as ”professional development,” ”simulation design,” ” interprofessional education,” ”debriefing process” and ”learning and performance evaluation” (Violato et al., 2023). In particular, pre-briefing (Penn et al., 2023; Miller et al., 2021) was included as one of the standards (McDermott et al., 2021), based on which we have created a checklist for evaluating our method, as shown in Figure 2. A high-fidelity simulation expert, who was responsible for managing the simulation session, was asked to fill out the form. We believe this following set of recommendations to be particularly useful, as a recent review (Barlow et al., 2024) noted that few studies clearly articulate how their methods aligned with these standards.

Pre-simulation Evaluation Form

Dear Evaluator, kindly refer to the provided reference for comprehensive information and details of each criterion.
INACSL Standards Committee et al. (2021). Healthcare Simulation Standards of Best Practice™ Prebriefing: Preparation and Briefing. Clinical Simulation in Nursing, 58, 9-13.

Evaluator — Date of the review: November 2023

Scoring	EXCEEDS	MEETS	NEEDS IMPROVEMENTS
Criteria	**Exceeds**	**Meets**	**N.I.**
General Criterion 1: The simulationist should be knowledgeable about the scenario and competent in concepts related to pre-briefing.	✓		
General Criterion 2: Pre-briefing should be developed according to the purpose and learning objectives of the simulation-based experience.			✓
General Criterion 3: The experience and knowledge level of the simulation learner should be considered when planning the pre-briefing.		✓	
PREPARATION			
Criterion 4: Based on the needs assessment and the purpose of the experience, preparation materials are developed to ensure that learners are prepared for the experience and can meet the scenario objectives.			✓
Criterion 5: Preparation materials should be developed according to the purpose and learning objectives of the simulation-based experience.		✓	
Criterion 6: Plan the delivery of preparation materials both prior to and on the day of the simulation-based experience.		✓	
BRIEFING			
Criterion 7: Prior to the simulation-based experience, the simulationist conveys important information to learners regarding expectations, the agenda, and the logistics for the experience.			✓
Criterion 8: Conduct a structured orientation to the simulation-based learning environment, including the modality.		✓	
Criterion 9: Establish a psychologically safe learning environment during the pre-briefing.	✓		

Figure 2: Pre-briefing evaluation checklist based on the INACSL standards (McDermott et al., 2021).

Based on the expert’s feedback and our analysis of the case study results, we have compiled improvements for our pre-briefing method according to each criterion in the INACSL standards (McDermott et al., 2021):

- Criterion 1: for our case study, the simulation manager was an experienced anesthesiologist who, in collaboration with a medical informatics researcher, implemented the pre-briefing (videos, quizzes). However, we recommend involving more experts, particularly ones who specialize in high-fidelity simulation, e-learning and psychology, such that they can set up a comprehensive set of quizzes and resources to prepare the students for the simulation.
- Criterion 2: meeting the learning objectives becomes a difficult task when only using digital quizzes and videos. Rather, we think it is still necessary to rely on traditional methods, such as written learning material, to teach the required knowledge to the students during the pre-briefing. Quizzes can help the learners in re-orienting their studying efforts and improving their retention, as has been shown with the testing effect (Arnold and McDermott, 2013; Izawa, 1971), but they are not a substitute for other resources such as lectures meant to teach the content as a first step. Digitization can facilitate access to the learning material, e.g., with the help of a mobile quiz app, but the content itself should not be reduced in the process by purely relying on quizzes, which are not an ideal teaching medium.
- Criterion 3: although we designed preparation quiz questions based on research. However, based on the students’ post-simulation feedback, the pre-briefing quizzes would benefit from more in-depth questions specifically in terms of the theory. To that end, the content of the quizzes needs to be better aligned with the student’s curriculum, such that the questions do not appear as simple repetitions of topics they have already studied recently. Rather, the quizzes should also fill any gaps in knowledge in terms of concepts not typically covered in their lectures and similarly allow the students to test themselves with practical questions.
- Criterion 4: to aid the learning experience, more general resources regarding psychology should also be provided to the students, rather than only covering the simulation scenario’s topics.
- Criterion 5: a diverse set of formats for the pre-briefing material can be useful, as each student has their preferences when it comes to how they study. As such, while digital quizzes and audio-visual material may seem helpful for some, traditional methods such as written guides should also be offered to support a broader range of learning modalities.
- Criterion 6: based on the students’ own complaints from our case study, we recommend offering the pre-briefing resources, including in different formats as previously noted, though with-

out imposing a requirement that they must complete a certain set of tasks before being allowed to participate in the simulation. The simulation itself is what the students are to be evaluated on, meaning how they prepare themselves during the pre-briefing should not matter to the teacher. Providing the students with the learning material, while still giving them the freedom to organize their preparation can best suit each student's self-regulated learning.

- Criterion 7: as per our observations and results, we need to apply all steps in the current Criterion in the following study. We highly recommend preparing a comprehensive document covering all aspects, especially students' roles and team-based communication, in any suitable format.
- Criterion 8: we found that teaching the modalities of the high-fidelity manikin was difficult through the digital quizzes. Instead, we would suggest not only written tutorials explaining the manikin's functionality but also a virtual simulation room tour before the actual session. The latter would not only help the students get a hands-on experience with the general controls and monitoring displays of the manikin, but it could also reduce their anxiety by familiarizing them with the environment.
- Criterion 9: an issue we faced with our case study was the limited amount of time we could dedicate to each simulation group. This lack of time not only made the students feel pressured to quickly learn how to handle the manikin before being able to start with the basic life support scenario, but it also did not allow the simulation teacher to offer individual feedback to each student after the session. While debriefing was not the focus of our work, it is still an important aspect in reinforcing the students' learning outcomes. As a result, we recommend allocating more hours for simulation in the curriculum to allow teachers much time to manage all phases of the simulation session and cover all aspects of this criterion.

6 CONCLUSION

Pre-briefing can greatly help in preparing students for high-fidelity simulations with manikins. Our work proposed a testing-based approach through the usage of digital quizzes whose difficulties are adapted to each learner's skill level, as well as demonstrative videos. Our case study revealed that this testing focus is not enough, as the students still require learning material such as written guides and lectures to acquire the required knowledge. Testing can improve their retention and help them identify topics they have not mastered yet, but it cannot teach the underlying content effectively. Based on our findings and based on the INACSL pre-briefing criteria, we proposed several improvements for our method to achieve comprehensive pre-briefing.

For future work, we intend to implement the proposed improvements and conduct additional simulations using our pre-briefing approach. Given the importance of debriefing, we are developing a plan to provide students with automatic and personalized debriefing reports by integrating proactive computing(Dobrican and Zampunieris, 2016) during and after simulations.

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