

Long-Term Effect of Large-Scale Simulation Curation and Participation

Lindsey E. Eberman, PhD, ATC*; Elizabeth R. Neil, PhD, ATC†; Kelcey Granger, MS‡; Zachary K. Winkelmann, PhD, SCAT, ATC§

Departments of *Applied Medicine and Rehabilitation and ‡Teaching and Learning, Indiana State University, Terre Haute; †Department of Health and Rehabilitative Sciences, Temple University, Philadelphia, PA; §Department of Exercise Science, University of South Carolina, Columbia

Context: Previous research has found simulation with debriefing to be helpful in developing self-confidence, improving clinical competence, identifying knowledge deficits, and implementing knowledge into practice in the short term. However, the long-term implications of simulation curation and participation are unknown.

Objective: The purpose of this study was to evaluate the long-term effect of large-scale simulation curation and participation as part of an advanced-practice athletic training course.

Design: Qualitative phenomenological approach.

Setting: Video-conferencing software.

Patients or Other Participants: From among 60 potential participants, 11 individuals participated in a long-term, follow-up interview to explore their recollections, perceptions, and subsequent experiences from curating and participation in large-scale simulation.

Main Outcome Measures: Deidentified transcripts were checked for accuracy and sent for member checking. Subsequently, a 3-person data analysis team used several sequenced rounds of review, aligned with consensual qualitative research, to analyze data. Trustworthiness was established with member checking, multianalyst triangulation, and auditing.

Results: Three domains emerged from the data: emotional reaction, improvements to practice, and the value of debriefing. When the *emotional reaction* domain was described, learners focused on the *reality*, *overload*, and need to *maintain composure* of the encounter. Within their clinical practice, *improvements* were made primarily regarding *mindset*, *teaching*, *collaboration*, *emergency planning*, and *triage*. Finally, learners noted the *value of debriefing* as *humbling*, a time for *realized deficiency*, and a time of *emotional decompression*.

Conclusions: Simulation-based learning in advanced-practice clinicians leads to perceived increase in skills such as intra- and interpersonal skills and emotional readiness. Long-term effects of simulation demonstrated that learners could translate these skills into clinical practice even 2 to 3 years post experience. Finally, the use of debriefing is a critical component to both the learner's skill acquisition and translation of knowledge in all simulation-based experiences.

Key Words: Quality improvement, consensual qualitative research, debriefing, cognitive overload

Dr Eberman is currently a Professor and Program Director in the Department of Department of Applied Medicine and Rehabilitation at Indiana State University. Please address correspondence to Lindsey E. Eberman, PhD, ATC, Indiana State University, 567 N 5th Street, Room A-10, Terre Haute, IN 47809. lindsey.eberman@indstate.edu.

Full Citation:

Eberman LE, Neil ER, Granger K, Winkelmann ZK. Long-term effect of large-scale simulation curation and participation. *Athl Train Educ J*. 2023;18(1):5–15.

Long-Term Effect of Large-Scale Simulation Curation and Participation

Lindsey E. Eberman, PhD, ATC; Elizabeth R. Neil, PhD, ATC; Kelcey Granger, MS; Zachary K. Winkelmann, PhD, SCAT, ATC

KEY POINTS

- Two to 3 years after engaging in a large-scale simulation experience, advanced practice clinicians still recalled their emotional reactions, identified areas of improvement in their practice, and spoke to the value of debriefing as part of the experience.
- Large-scale simulation can stimulate real feelings including feeling overloaded and a need to maintain composure. Although in some disciplines creating this intense environment may not be warranted, a profession like athletic training, which requires competence in immediate and emergency care, needs high-intensity emergency simulations to replicate the potential experience for learners.
- Participants described long-term improvements in their practice 2 to 3 years after the large-scale simulation, suggesting there is a lasting effect well beyond the immediate experience.
- Debriefing is a critical component to simulation, and participants appreciated the opportunity to emotionally decompress and learn from their mistakes alongside classmates.
- Participants were able to learn humility from being able to discuss their errors and plan for improvements through the debriefing process.

INTRODUCTION

Throughout the years, educational theorists have contextualized learning around the creation of real-life scenarios and application to drive translation of knowledge and skills. Experiential learning theory, first described by Kolb in 1984,¹ emphasizes transformation because of an experience. Within this theory, knowledge is not only gained through the transformative experience but also contextualized through reflection.¹ In 1910, John Dewey first described reflective learning theory, which is the process of recalling the learning experience and posing questions that explore why the outcome resulted as it did and if other actions would have yielded a different outcome.² Reflection is a critical stage of experiential learning and allows learners to create new meaning and test new hypotheses in future similar situations. In health care education, experiential learning theory has been seen across the professions using real-life clinical education as well as through simulation.^{3–6} Most of the previous literature in health care education has focused on the short-term effects of experiential learning, but health care professions rely heavily on the theoretical benefits of experiential learning to develop high-quality providers in the long term.

The use of simulation, a learning experience that mimics real life, has continued to grow in popularity in health care over the last 100 years.⁷ Previous research on the short-term effects of simulation have demonstrated positive outcomes and growth in learners including knowledge, skills, self-confidence, anxiety and comfort level, and the cooperation with and between health care students.⁷ Additionally, research has

supported the concept that there are equal benefits in the short term for both those in the role of learner and observer in a simulation.⁸ The notion of both the learner and observer has also revealed skill transfer into that of clinical education or work settings.^{8,9}

The long-term effects of simulation are largely unknown, but 2 recent qualitative studies in athletic training, one at the professional level and another at the advanced, postcredentialed level, have identified benefits. Professional-level learners with 1 to 6 years of practice experience, following completion of their educational program, described the personal and professional growth and development gained as a result of having multiple standardized patient encounters, a form of simulation where an actor is trained to portray a patient scenario.¹⁰ Specifically, these participants described personal development in communication, patient rapport, and self-reflection.¹⁰ Additionally, they indicated that the standardized patient encounters provided them with realistic patient experiences, thereby aiding in transition to practice and enabling them to practice making clinical decision and engage in patient-centered care.¹⁰ In a study of advanced-practice athletic trainers, learners reported translating new knowledge and ways of thinking into practice as well as enhancing self-reflective practice 60 days after a standardized patient encounter.¹¹

What is known about the effects of simulation curation is also somewhat limited. In occupational therapy education, co-constructed simulations with instructors serving as facilitators yielded insights into self-regulated learning as a result of serving multiple roles, interacting with the instructor and peers, and multistage development.¹² A previous study¹³ described the educational technique of student-curated large-scale simulation in advanced athletic training practice and hypothesized its association with experiential and reflective learning theories but have yet to characterize the effect. Therefore, the purpose of this study was to evaluate the long-term effect of large-scale simulation curation and participation as part of an advanced-practice athletic training course.

METHODS

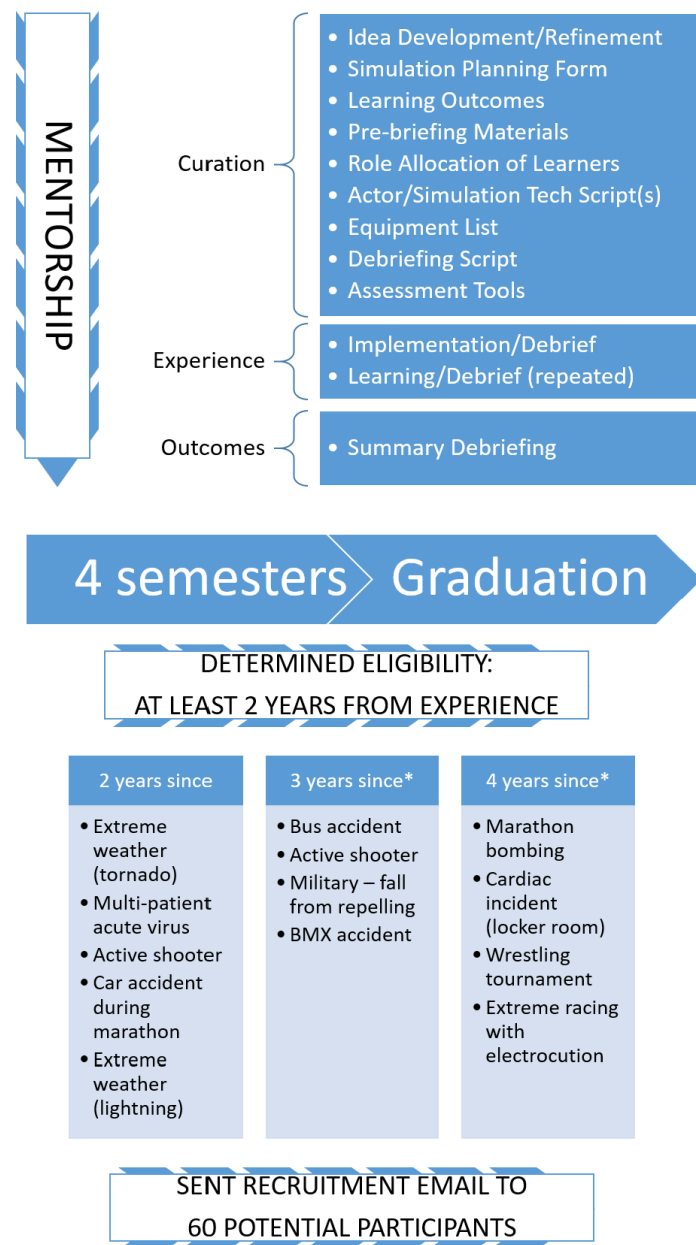
Design

We used a phenomenological approach to evaluate the lived experiences of advance-practice learners who engaged in and curated a large-scale simulation, and we used the Standards for Reporting Qualitative Research, as is best practice, to guide the methodological approach to the research design.¹⁴ The study obtained approval from the Indiana State University Institutional Review Board and included audio-recorded semistructured interviews.

Participants

Participants were included in the study if they had graduated from the Indiana State University Doctor of Athletic Training

Figure 1. Simulation curation, implementation, and participant experiences based on eligibility.



Program and had completed the simulation experience at least 1 year before the scheduled interviews. All learners had completed the simulation curation and participation as part of the mandatory curricula for their education. The curation of the simulation learning experience as part of the program is described in detail as a 3-part modular series¹³ leading up to the large-scale simulation (Figure 1). In total, 3 cohorts of students (N = 60) were eligible to participate in this study, those with at least 2 years since the large-scale simulation experience. Graduates were contacted via email (1 initial email, 2 follow-up emails in Fall 2019) to determine their interest in participation. Nine participants volunteered in the fall recruitment period, but we again sought additional volunteers in Spring 2020 to ensure data saturation had occurred. A total of 11 people participated in this study (Table 1).

Instrumentation

Members of the research team created the interview script and engaged 3 expert reviewers in simulation curation (n = 2) and qualitative research (n = 1) to evaluate the script. Minor editorial changes and sequencing of questions were made as a result of the external review. One member of the research team practiced the interviews 3 times before conducting all the interviews. The semistructured final interview script comprised 8 questions with subsequent follow-up questions as appropriate (Table 2). There were no iterative changes made to the interview script during data collection.

Data Collection Procedures

One member of the research team (K.G.) conducted each of the audio-only interviews by Zoom meeting (Zoom Video Communications Inc) between November 2019 and March 2020. At the onset of the interview, participants provided verbal informed consent, age, years of experience, gender, and time since graduation. The interviewer then continued with the 8-question semistructured interview (Table 2). Throughout each interview, the interviewer engaged in reflexivity by jotting notes to address their own biases and assumptions,¹⁴ specifically to acknowledge that the learning activity could yield both benefits and strain on the learners. Interviews ranged from 13 to 36 minutes (average, 26 ± 8 minutes). At the completion of the interview, the audio files and transcripts were downloaded. The transcripts were deidentified by the interviewer and saved to a secured cloud server. This ensured participant protection as well as an unbiased data analysis process, as a member of the coding team was also the instructor of record. Participants were sent their transcript to verify the accuracy of the transcript.

Data Analysis

We used the consensual qualitative research (CQR) method to analyze the interviews in this study. Three members of the research team (L.E.E., E.R.N., K.G.) completed the coding process (Figure 2). In following the CQR tradition, the members of the coding team completed phase 1 by each reviewing 4 transcripts individually while taking notes on common core ideas throughout the interviews. The coding team then met, discussed the findings, and created the preliminary codebook. For phase 2, the research team took 2 transcripts from the first phase and 2 new transcripts to review the validity of the preliminary codebook. The team met and made minor revisions to the codebook, thus creating the consensus codebook. In phase 3a, each member of the coding team independently coded 4 unique transcripts for the domains and categories within the consensus codebook. The team then exchanged transcripts for phase 3b, to review the previous coding.

A consensus meeting was planned where all codes were confirmed with at least two-thirds agreement. We used an external auditor (Z.K.W.) to review the consensus codebook against a sample of transcripts. Categories were assigned as *general* if identified in 11 cases, *typical* if identified in 6 to 10 cases, *variant* if identified in 3 to 5 cases, and *rare* if identified in 2 or fewer cases. To address research reflexivity, the research team used the CQR process to minimize biases that may have emerged from their perspectives on simulation-based learning.¹⁴ The research team also executed other reflexive qualita-

Table 1. Participant Demographics

Name	Gender Identity	Age	Years of Experience	Years Since Simulation Experience	Setting
Abby	Woman	25	4	3	Public service
Anthony	Man	27	5	4	College or university
Donald	Man	29	6	3	Industrial
					Academic
Eleanor	Woman	25	3	3	College or university
Jimmy	Man	49	23	4	College or university
Leon	Man	34	10	4.5	Secondary school
Leroy	Man	41	16	3	College or university
					Academic
Maria	Woman	29	5	3.5	College or university
Sasha	Woman	27	4	4	Secondary school
					Community college
Timothy	Man	36	7	4	Military
Ziva	Woman	27	6	3	Academic

tive behaviors such as member checking, multianalyst triangulation, and limited biases between interviewer and interviewee by ensuring no previous relationship (teaching, facilitating the simulation, or otherwise).¹⁴ Deidentified excerpts from the participant's interviews are presented to verify the data.

RESULTS

Three domains emerged from the data (Figure 3): (1) emotional reaction, (2) improvements to practice, and (3)

value of debriefing. These domains were further characterized by categories detailed in Table 3.

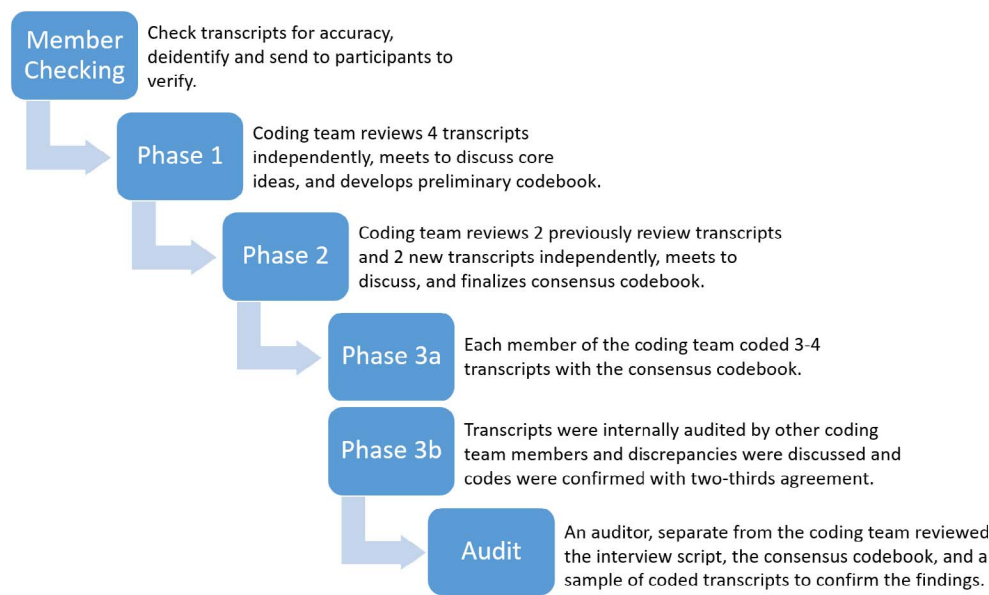
Participants described having an immediate emotional reaction to the simulation experience (Table 4). They attributed that reality to how they tried to make sure it was real for their classmates, which was reciprocated in the simulations they engaged in as learners. On occasion, participants indicated that the simulations were less realistic when they recognized the actors or their classmates or were assigned duties that did

Table 2. Interview Script

Question and Planned Follow-up Question

- To begin the interview, could you please describe the student-curated simulation experience that you were a part of in the second semester of the program? Please describe the process of curating the simulation experience over the course of the semester?
 - If at all, how did developing the simulation influence your clinical practice?
- What do you recall from the simulation day, relative to the simulations you participated in?
 - How did they make you feel?
- What was the most impactful part of the day?
 - Was this positive or negative for you?
- After finishing your DAT, do you feel your participation and experience in the simulations changed your patient-care? If yes, explain how so.
 - If the participant states they made changes or created simulations:
 - What do you feel, specifically, inspired the change in your patient care?
 - Did you need resources to implement the change/these changes in your patient care? If so, what resources?
 - If at all, how do you feel the simulation experience provided you the education and training necessary to implement change in your patient care?
 - Did you face any barriers to your new practice or way of thinking?
 - If so, where you able to overcome them?
 - If not, why not?
- Are there any other things you have done differently as a healthcare provider since the simulation? If so, please describe.
- In your clinical practice, have you experienced similar situations as to what occurred during the large-scale simulations? If so, please describe.
 - How did you respond? The same? Differently? Please detail.
- Have you had any instances where you found yourself reflecting on the simulation experience in your clinical practice regardless of similarity to what occurred during the simulation experience?
 - If so, please describe.
 - If not, why do you think you have been unable to translate what you learned during the experiences?
- Do you have any additional comments or experiences you would like to share or elaborate on at this time?

Figure 2. Process of coding and establishing trustworthiness of the data.



not align with their skillsets, which was avoided as much as possible. The simulations were planned consecutively over the course of the day, and as such, participants described feelings of both cognitive and emotional overload. Although rarely did a student participate in more than 1 simulation as a learner, and they only delivered 1 simulation of their own, they often described an emotional energy drain at the conclusion of the learning activity. Some of this overload was described as a means of reinforcing the connections the participant had during the debriefing experiences. During the simulations, the participants were pleased when they were able to maintain composure but acknowledged how difficult that was when there were multiple patients and exacerbating environmental factors that enhanced the fidelity of the simulations.

Improvements and professional development were a direct result of the simulation curation and participation. Participants noted a mindset shift. Some were able to see the immediate effect, as their classmates were able to immediately implement knowledge, skills, and abilities that revealed themselves as deficiencies in the previous simulation debriefing. In addition, participants described a direct translation of the activity as being emotionally prepared for future incidents, specifically when preparing for death and dying within their

practice. From a skill perspective, participants found themselves improved at triaging patients in an emergency scenario. Logistically, participants noted that the experience prepared them for emergency planning. Some noted that after the experience, they saw simulation as a way to assess the deficits in their teams and plan for improvements. Interestingly, collaboration through effective communication was critical to success in these chaotic emergency simulations; however, only half of the participants identified collaboration and communication as a continued improvement in their practice. One participant could see that curating the simulation in teams also had value. Specifically, the simulation activities prepared them to use those skills to teach others, both in a practical and an academic environment.

Figure 3. Domains and categories representing the lived experiences of students who participated in and curated large-scale simulations.

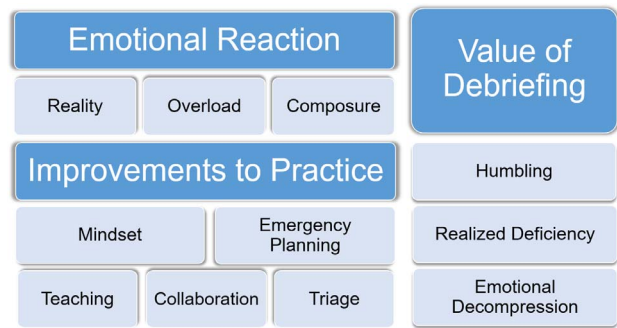


Table 3. Domains and Categories^a

Domain and Category	Counts	CQR Assigned Value
Emotional reaction		
Reality	10/11	Typical
Overload	11/11	General
Composure	9/11	Typical
Improvements to practice		
Mindset	10/11	Typical
Triage	8/11	Typical
Emergency planning	11/11	General
Collaboration	7/11	Typical
Teaching	9/11	Typical
Value of debriefing		
Humbling	11/11	General
Realized deficiency	9/11	Typical
Emotional decompression	9/11	Typical

Abbreviation: CQR, consensual qualitative research.
^a Categories were assigned as *general* if identified in 11 cases, *typical* if identified in 6 to 10 cases, *variant* if identified in 3 to 5 cases, and *rare* if only identified in 2 or fewer cases.

Table 4. Quotes Representing the Domains and Categories

Domain & Category	Participant	Quote
Emotional reaction Reality	Jimmy	I just remember the reality. The simulations were very, very well done with the fidelity. The fidelity was really strong, and it felt like all of the situations were real, and that allowed me to go through unhindered. There was never a break in this procedure or in this scenario as I was giving care. It was just a continual situation until the end. And so, that's the big thing that stands out to me, that the fidelity was good. It felt real. It felt like the situation was actually happening at that time.
	Abby	It becomes much more real. You realize this could be a real thing and you kind of put yourself in the seat of "What would I do if I was one of the athletic trainers that was assigned to play this role?" I think that thought comes up before the thought of "what if this happened at my school" because you can distance yourself enough from it happening in real life. But then you go, "I don't know how I would treat this person or do in this simulation," and then once it actually plays out, you say, "What would I have done if this happened in my actual school?"
	Sasha	In one simulation, I was a coach. The skill that I was expected to have was only basic first aid. That was kind of hard, as an athletic trainer in reality, knowing and having more skills than I'm able to give in that moment, but you kind of have to stay in your role. That was a little bit frustrating and that was kind of hard internally. But I think it gave me a good perspective of how our coaches feel, like a little bit helpless, where they may be called to action but don't necessarily have the skills that we do. I think it gave me the ability to kind of step into somebody else's perspective of what simulations could look like or what a real-life emergency situation can look like from their perspective.
	Donald	When we engaged in the active shooter simulation, the fidelity of it was so high. It was also weird because a lot of the actors were also people who I knew. I was trying to get myself to buy into it. Then I was just where I was trying to figure out the best strategy to treat the patients, but also survival.
Overload	Sasha	They were definitely very high stress and high emotion. I just remember being really exhausted at the end of that day with so many different scenarios and simulations.
	Jimmy	I do remember being mentally drained and mentally tired at the end of that day. I do remember just being you know just mentally worn out.
	Anthony	When you are put into these kinds of situations where you know that everyone is high intensity, and we're all helpers and caregivers. We're trying to like save this person. It really gets you into the mindset of "Oh my gosh. Someone's going to die." When you get put into that situation 4 times within like a 2- to 3-hour period; it was pretty intense.
Composure	Timothy	It showed me an example of how to handle a situation. Even a mock situation can have those physiological responses and can increase heart rate, respiration, sometimes confusion. But having a plan and executing that plan goes a long way in controlling those.
	Leon	Because of the physical response and the adrenaline high that you get, you don't think you just react to an extent. I mean, you think, because you have worked hard and you train well that you know what to do.
Improvements to practice Mindset	Leon	You look at things differently. You tweak your outlook on stuff, and it makes the way you do things so different, because you see all aspects of it, and everything is very clear as to what your goal is. As an athletic trainer for that day talking about the specific goals of that simulation really helped me know what my goals are at each event, other than just everybody going home safe. Having a vision and setting goals for each event is really how my practice changed.
	Abby	Throughout the day, as you do more simulations, you bring more skills with you. With the first one, no one had any idea that we needed to triage. So, it was just chaos everywhere.

Table 4. Continued

Domain & Category	Participant	Quote
Triage	Ziva	You learn what should be done with someone who is near death and you're going through that emotional state of trying to revive a patient. Hopefully none of us ever have to do that, but you are able to tap into those emotions. That was really covered in the debrief after the simulation when we talked about the experience, what happened, and how you feel. We heard a lot of lot from people who have lost patients and how they emotionally went through the process. Losing other people too, losing people close to you. I really took a took a turn in to what it is to lose someone close to you.
	Maria	The idea with our simulation was everything was happening all at the same time. We put our classmates in a situation where they would not only have to manage each patient, but they would have to manage their fellow athletic trainers. They had to manage the crowd and as many patient-actors at a wrestling tournament as possible.
	Eleanor	Our learning objectives primarily focused on triage, being able to respond appropriately, as well as dividing up tasks and communication. We also wanted them to learn to leave a patient that wasn't going to make it and provide help to those that had a better chance of survival. That was something that other athletic trainers really get to see. Hopefully, they don't have to see that very often. Those were our learning objectives: being able to let a patient go and then go from there to help the other patients that were on the scene.
Emergency planning	Leroy	This simulation focused on policies and procedures. Students were practicing their emergency action plans and communicating with first responders. We can't just do it on an annual basis, but each season with rehearsals. That's the emphasis of what I learned from the simulation and knowing what bad situations happen. But if you have a plan for it, things tend to go better if you have a plan.
Collaboration	Jimmy	It's from a planning standpoint. It's more for the catastrophic issues and the more emergency situations for preplanning. That is mostly the way the simulations have affected my clinical practice; helping me interact with our clinical staff or our students before an event and going through a plan and making sure that we're on the same page.
	Timothy	The simulations helped me with working as a part of an interdisciplinary team. I didn't know it at that point in time, but it served me greatly in this position. If I didn't get my task done, the product wasn't going to be as good as it could be, and someone else is going to have to pick up the slack. So, working within the groups for the simulation has helped me in my current position, just as taking my part of any given task and getting my part done in a timely matter.
	Leon	I felt like I was learning how to be a coach or how to talk to a parent and deliver bad news. At the time, I checked out and was like, "Whatever, I don't want to be doing this." But those skills are transferable as an athletic trainer. You always have to talk to parents and calm them down when things are going on.
Teaching	Leroy	I start off with low-fidelity simulations to create experiences for a hands-on environment. We have moved into doing some higher fidelity things. We haven't gotten to do an emergent situation like we did, but it'd be kind of cool to coordinate and plan with other groups to do an interprofessional activity to that effect.

Table 4. Continued

Domain & Category	Participant	Quote
Value of Debriefing Humbling	Anthony	Luckily, I had the resources and the ability to teach those students at that time and create a simulation for them to have a learning experience. Having events like that and having preceptors challenge students, in that way, is unconventional. Hopefully, simulations become more conventional, but I think that's valuable for the students and for individuals who are working as athletic trainers in at least the collegiate setting. How often do those athletic trainers sit down together and say, "Alright, let's practice this, because this could happen." Instead of going through the motions like CPR training once every 2 years. And says, "Okay, we're going to practice C-spine in the field like it always happens." It's like, "What about if it happens like this? What if it happens in a way that we're not ready for? We should plan for that. Or what happens if EMS [emergency medical services] isn't there?" We have 3 events going on on campus, which happens a lot for us. And, they have to respond to a ball to the chest at the baseball game, and at the lacrosse game, they have a C-spine incident. What do you do? I know for sure we're not prepared for that at my institution. And how do you plan for that? Well, you've got to get your staff on board. You've got to develop the time to do these trainings or simulations. You need to plan, and you really have to get the buy-in of your supervisors or the stakeholders who control these events and really get them to understand the need.
	Abby	I felt a bit helpless, but not in the sense of self-loathing or anything like that. I felt helpless more in a sense of what if I didn't have this exposure? What would I have ever done in this real situation? But then, as you reflect in the debrief portion, you also realize this isn't something that you can reasonably expect to accomplish yourself. In reality, would I be able to make everyone feel okay, and package them up in a perfect little bow, and put them into 10 different ambulances all by myself as the only health care provider? No, I couldn't do that.
	Maria	Honestly, just practice and confidence. I was able to literally practice, with a safety net, different situations that are possible, and in any setting for us, and then, debrief on ways that it affected us. It made it better, with things to improve on.
Realized deficiency	Donald	I think the most impactful part was the fact that I saw my classmates and how humble they were, especially as we got into like the third and fourth simulations. We were very humbly saying, "This is what I didn't do well, this is what I should have done or could have done, or this is what I will do next time." I also just became extremely close to these individuals. You just get to know people, and you get to learn from them and from their failures and successes, as well as your own.
	Ziva	Sitting down and hearing all my classmates, or the other people participating in this simulation, and their point of view and what they did well and/or what went wrong and just being able to talk through how we felt in those scenarios. How can we prepare better? That was the thing that resonated with me, just being able to talk in a group about it and hear everybody's perspective.
	Sasha	Because I feel like that's where most of the value is in my personal opinion. Having the chance to step back and say, "What did we do really well? What did we do not so well? Is there a way we could make this better? Was there a logistic issue for example?"
	Eleanor	We all felt incompetent about things that we can do as health care providers. And, that in itself probably impacted me the most, because not only did I get to see that I wasn't the only one flailing around wondering what I was supposed to be doing, but I was also able to reflect on that and then look at how to improve my care in the future.

Table 4. Continued

Domain & Category	Participant	Quote
Emotional decompression	<i>Eleanor</i>	I was able to adopt aspects that can be easily implemented. For instance, debriefs. I brought that into my practice and even if it's something like having an asthma attack, I debrief with students, or I debrief with the staff, and we talk about what could have gone better. I think that it's important to be in an environment where you're open to what a simulation can teach you. <i>(Also coded as teaching)</i>
	Anthony	At the end of it, I think we all just sat for a little while and just breathed because it really puts a toll on your mind in terms of how you responded, did I do this right? Or if this really did happen, did I do the right thing? Did I do enough? Could I have done enough? It's not only in the moment where you're like, "Okay, what can I do?" But then afterwards, you're thinking if this does happen, did I do it right? Am I going to be ready to do it again? If the simulation failed, am I going to fail again. You're questioning everything after that, which is why the debrief was really important.
	Leon	When it's done, you've got to take a break and sit down and rest. Then you sit and you ask yourself, "Oh, God. Did I do this right? Did I do that wrong? Could I have killed someone?" Once you talk through that, you recognize what has really changed in my practice. The most important thing is taking time to sit down and think: "What did I do better? Where did I succeed? Where did I fail? How can I learn from my failures? What do I need next time to be more successful?"

Participants collectively indicated that the most effective parts of the experience occurred during each debrief. The debriefing was humbling for all participants, where they described having this critical time for reflection. Many felt the debriefing brought them closer to their classmates. The debriefing allowed the participants to be vulnerable and verbally recognize their deficiencies, while also supporting their classmates when they recognized their own errors. This process had a lasting effect on some participants as they were able to replicate this kind of experience when teaching others. Participants appreciated the debriefing experiences because they allowed them time and space to emotionally decompress and prepare for the future in a safe space.

DISCUSSION

Our findings suggest that large-scale simulation can lead to immediate and long-term learning benefits for practice, and moreover that reflection was likely the most effective component for creating change in future practice. Debriefing after a simulation-based learning experience helped students process what they had just experienced, discuss skills and concepts that were deficient, and build a sense of community. Participants also discussed how these experiences allowed them to be prepared for future similar situations and share this knowledge with others.

Experiential and Reflective Learning

Experiential learning is an active learning process by which the learner constructs new knowledge by linking new experiences with previous knowledge. Simulation-based learning is an extension of this pedagogical method and is used to "replace or amplify real experience with guided experiences."¹⁵ Literature suggests that experiential learning is more likely to produce behavior and attitude changes than didactic modes.¹⁶ Our participants discussed many ways that these

experiences changed their patient care, pre-event rituals, emotional readiness for emergent situations, and teamwork.

One key element that enhances experiential learning is fidelity. Fidelity means creating an experience for the learner that is believable and reflects reality.¹⁷ Fidelity is important when the learning outcome is to translate knowledge from the created experience into clinical practice.¹⁸ Our participants described that fidelity was high in most simulations, creating an urgency to act and an emotional reaction to the scenario. Participants also indicated that fidelity diminished if they recognized the actors or the actors had a different skillset than what the learners knew them to have. Low-fidelity simulation may increase skill development immediately, but long-term skill retention is lower.¹⁸ The participants in our study were able to articulate knowledge, skills, and abilities they learned directly from the curation and participation in large-scale simulation from 2 or more years after the experience. This finding supports that high-fidelity simulations do have long-term effect on clinical practice.

Simulation-based learning is ideal for providing hands-on, risk-free patient encounters to teach specific skills that students are likely to experience in the real world. Our participants discussed both the short- and long-term effects on clinical practice as a result of this curation and participation in these simulations. Short-term effects of simulation are largely skill-based improvements, including gaining technical skills, knowledge, self-confidence, and clinical competency.^{7,19} Similarly, our participants articulated skills and abilities they learned immediately and could transfer to the next simulation on that same day. Skill transfer has also been identified as a direct benefit after a simulation experience; specifically, anesthesia trainees performed better after simulation than participants receiving interactive seminars alone.⁹ Our participants stated that they could use skills immediately in their clinical practice, but most of the skills they discussed related to long-term effects on their clinical practice.

The long-term effects identified by participants included improved interpersonal skills, health care competency, and emotional readiness. Simulation-based education can help prevent skill decay.^{10,20–23} Specifically, some learners have noted that some skill decay has happened, but that their end point was still better than baseline prior to the simulation.¹⁰ After being exposed to simulation-based learning in a professional athletic training degree program (precertification), those learners spoke to the personal and professional development they gained from engaging in simulation. The findings from this study,¹⁰ as well as our current findings, as well as our current findings are novel within the health care literature. Previous work on long-term simulation effects has primarily focused on skill performance and retention, while our participants noted the long-term benefits in more soft skills. Previous literature found “professionalism” was among the only soft skills retained in the long term as a result of simulation.^{10,24} Our participants not only spoke about emotional readiness for an emergent situation but also described being prepared because they were able to recall and reflect on previous poor performance, certainly a characteristic of professionalism. In our study, the skill acquisition and retention appeared to be with the decision-making itself in those difficult situations, and less so on the specific health care delivery. This may be a result of the kind of learner, as most of the previous research has focused on professional-level learners.

Debriefing was described by our participants as one of the most important parts of the learning experience. This peer-led communal discussion allowed them to reflect on the events that took place in relation to the learning objectives and critically assess their performance as a health care provider as well as their performance as collaborating clinicians. Participants described the debrief as a learning environment that was mutually beneficial for their professional growth and improved the relationships with their peers. They expressed how hearing their peers acknowledge errors led to their own willingness to be vulnerable. Effective debriefing can lead to enhanced learner performance and specific clinical skill acquisition.^{25,26} The literature suggests that most of the learning during simulation came from either the debrief or the reflective learning.²⁷ Previous research notes that debriefing can lead to a closer relationship between facilitators and participants of the debrief,²⁸ and in the case of our participants, the peer-led debriefing created closer relationships to those peers.

Although the experience itself is the catalyst for future learning, constructive and meaningful reflection is the fuel for future change in performance. In experiential learning, Kolb theorized that after reflection, learners could construct new hypotheses and eventually test those in similar situations.² The participants in our study had multiple simulations throughout the day and could use the hypotheses created from the previous experiences and immediately apply them to the next. Exposure to multiple high-fidelity simulations has led to students feeling more self-confident in their skills, improving clinical competence, identifying knowledge deficits, and implementing knowledge into practice in the short term.²⁹ However, in testing conditions, such as an objective structured clinical examination (OSCE) experience, with self-reflection instead of facilitated or group debriefing, student performance did not improve between encounters.³⁰ Effective debriefing

requires participants who are willing to be self-aware, open to feedback, communicative, and vulnerable.²⁸ Dialogue that promotes an exchange between learners can result in long-term benefits to clinical practice, ultimately contributing to learning. Because of the importance of the debriefing and reflective piece, it is essential that facilitators, including peer-to-peer facilitators, are well versed in best practices of leading the debriefing process.^{12,13,31}

Social Constructivism. Experiential learning and reflection are focused heavily on the individual learner, and the theories often do not account for the social nature of the learning experience. Social Constructivism is an active learning theory by which learning occurs through experience but is contextualized by social influences.³² The key assumption of the theory is that individuals learn from one another and support each other by championing their own skills and abilities to help support other learner’s academic achievements.³² Research has suggested that for debriefing to be effective, the learners must be judgment-free so they can be appropriately reflective and willing to share their experiences.³³ This judgment-free learning environment minimizes fear and distress and allows students to become more reflective and likely to share their experiences.³³ Our participants described that their peers were influential in their emotional state throughout the day. They described learning from each other’s mistakes, celebrating each other’s successes, and discussing ways to improve, while acknowledging these kinds of experiences are likely to yield an emotional response.

Limitations

Participants in this study were all enrolled and graduated from the same doctoral program with which the researchers are all affiliated. While their opinions and testimony are all uniquely their own, their responses could have been biased based. In addition, the experience curating, implementing, and reflecting on the large-scale simulation may not be generalizable to other clinicians and/or those engaging in continual professional development without a structured doctoral program to guide the process. The results suggest promising evidence that simulation and reflection may lead to long-term benefits in clinical practice. Therefore, we suggest that future research be completed using a similar structure in other health care programs and throughout continuing medical education as a form of professional development to explore the active learning method of simulation.

CONCLUSIONS

At least 3 years after curating and participating in a large-scale simulation experience, advanced-practice clinicians still recalled their emotional reactions, identified areas of improvement in their practice, and spoke to the value of debriefing as part of the experience. Large-scale simulation can stimulate real feelings that include feeling overloaded and a need to maintain composure. Although in some disciplines, creating this intense environment may not be warranted, a profession like athletic training, which requires competence in immediate and emergency care, needs high-fidelity emergency simulations to replicate the potential experience for learners. Participants described long-term improvements to their practice, suggesting there is a lasting effect of simulation well beyond the immediate experience. Debriefing is a critical

component to simulation, and participants appreciated the opportunity to emotionally decompress and learn from their mistakes alongside classmates. Participants were able to learn humility from being able to discuss their errors and plan for improvements through the debriefing process.

REFERENCES

- Kolb DA. *Experiential Learning*. Prentice-Hall; 1984.
- Dewey, J. *How we think*. D. C. Heath; 1910.
- Coker P. Effects of an experiential learning program on the clinical reasoning and critical thinking skills of occupational therapy students. *J Allied Health*. 2010;39(4):280–286.
- Johnson BK. Observational experiential learning: theoretical support for observer roles in health care simulation. *J Nurs Educ*. 2020;59(1):7–14.
- Lisko SA, O'Dell V. Integration of theory and practice: experiential learning theory and nursing education. *Nurs Educ Perspect*. 2010;31(2):106–108.
- Poore JA, Cullen DL, Schaar GL. Simulation-based interprofessional education guided by Kolb's experiential learning theory. *Clin Simul Nurs*. 2014;10(5):e241–e247. doi:10.1016/j.ecns.2014.01.004
- Alanazi AA, Nicholson N, Thomas S. The use of simulation training to improve knowledge, skills, and confidence among healthcare students: a systematic review. *Internet J Allied Health Sci Pract*. 2017;15(3):2. doi:10.46743/1540-580X/2017.1666
- Delisle M, Ward MA, Pradarelli JC, Panda N, Howard JD, Hannenberg AA. Comparing the learning effectiveness of healthcare simulation in the observer versus active role: systematic review and meta-analysis. *Simul Healthc*. 2019;14(5):318–332.
- Bruppacher HR, Alam SK, LeBlanc VR, et al. Simulation-based training improves physicians' performance in patient care in high-stakes clinical setting of cardiac surgery. *Anesthesiology*. 2010;112(4):985–992.
- Armstrong KJ, Jarriel AJ, Hardin BM. The longitudinal impact of standardized patient encounters during professional education on athletic training professional practice. *Athl Train Educ J*. 2021;16(3):169–177. doi:10.4085/1947-380X-20-001
- Sims-Koenig KN, Walker SE, Winkelmann ZK, Bush JM, Eberman LE. Translation of standardized patient encounter performance and reflection to clinical practice. *Athl Train Educ J*. 2019;14(2):117–127. doi:10.4085/1402117
- MacKenzie DE, Collins KE, Guimond MJ, et al. Co-constructing simulations with learners: roles, responsibilities, and impact. *Open J Occup Ther*. 2018;6(1):13. doi:10.15453/2168-6408.1335
- Winkelmann ZK, Eberman LE, Edler JR, Livingston LB, Games KE. Curation of a simulation experience by the clinical scholar: an educational technique in postprofessional athletic training. *Athl Train Educ J*. 2018;13(2):185–193. doi:10.4085/1302185
- O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. *Acad Med*. 2014;89(9):1245–1251.
- Gaba DM. The future vision of simulation in health care. *Qual Saf Health Care*. 2004;13(suppl 1):i2–i10. doi:10.1136/qhc.13.suppl_1.i2
- Beaubien JM, Baker DP. The use of simulation for training teamwork skills in health care: how low can you go? *Qual Saf Health Care*. 2004;13(suppl 1):i51–i56. doi:10.1136/qshc.2004.009845
- Carey JM, Rossler K. *The How When Why of High Fidelity Simulation*. StatPearls Publishing; 2020. Accessed October 31, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK559313/>
- Kinney S, Henderson D. Comparison of low fidelity simulation learning strategy with traditional lecture. *Clin Simul Nurs*. 2008;4(2):e15–e18. doi:10.1016/j.ecns.2008.06.005
- Lamiani G, Mistraletti G, Moreschi C, Andrichi E, Vegni E. Cultivating empathy and soft skills among intensive care residents: effects of a mandatory, simulation-based, experiential training. *Ann Transplant*. 2021;26:e931147–e931141. doi:10.12659/AOT.931147
- Barry Issenberg S, Mcgaghie WC, Petrusa ER, Lee Gordon D, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach*. 2005;27(1):10–28.
- Braun L, Sawyer T, Smith K, et al. Retention of pediatric resuscitation performance after a simulation-based mastery learning session: a multicenter randomized trial. *Pediatr Crit Care Med*. 2015;16(2):131–138.
- Sullivan A, Elshenawy S, Ades A, Sawyer T. Acquiring and maintaining technical skills using simulation: initial, maintenance, booster, and refresher training. *Cureus*. 2019;11(9):e5729. doi:10.7759/cureus.5729
- Sutton RM, Niles D, Meaney PA, et al. Low-dose, high-frequency CPR training improves skill retention of in-hospital pediatric providers. *Pediatrics*. 2011;128(1):e145–e151. doi:10.1542/peds.2010-2105
- Guerrasio J, Aagaard EM. Long-term outcomes of a simulation-based remediation for residents and faculty with unprofessional behavior. *J Grad Med Educ*. 2018;10(6):693–697.
- McGaghie WC, Issenberg SB, Cohen MER, Barsuk JH, Wayne DB. Does simulation-based medical education with deliberate practice yield better results than traditional clinical education? A meta-analytic comparative review of the evidence. *Acad Med*. 2011;86(6):706–711. doi:10.1097/ACM.0b013e318217e119
- Tannenbaum SI, Cerasoli CP. Do team and individual debriefs enhance performance? A meta-analysis. *Hum Factors*. 2013;55(1):231–245.
- Cheng A, Grant V, Dieckmann P, Arora S, Robinson T, Eppich W. Faculty development for simulation programs: five issues for the future of debriefing training. *Simul Healthc*. 2015;10(4):217–222.
- Coutinho VRD, Martins JCA, Pereira F. Structured debriefing in nursing simulation: students' perceptions. *J Nurs Educ Pract*. 2016;6(9):127–134.
- Kaddoura M, Vandyke O, Smallwood C, Gonzalez KM. Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first degree accelerated bachelor nursing students. *Nurse Educ Today*. 2016;36:298–303.
- Tatachar A, Wettergreen S, Summers S. Reflective metacognition and objective structured clinical examination performance in introductory pharmacy practice experiences. *Curr Pharm Teach Learn*. 2020;12(10):1208–1214. doi:10.1016/j.cptl.2020.04.030
- Motola I, Devine LA, Chung HS, Sullivan JE, Issenberg SB. Simulation in healthcare education: a best evidence practical guide. AMEE Guide No. 82. *Med Teach*. 2013;35(10):e1511–e1530. doi:10.3109/0142159X.2013.818632
- Kemp S. Constructivism and problem-based learning. *Learning Acad*. 2011:45–51.
- Dreifuerst KT. The essentials of debriefing in simulation learning: a concept analysis. *Nurs Educ Perspect*. 2009;30(2):109–114.