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ORIGINAL RESEARCH

Let's face it. Individualizing a manikin by means of a lifecast face increases the flow that students experience during simulation training: results from randomized controlled pilot trial

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ABSTRACT

Introduction

This study explored the impact of incorporating a personalized moulage face mask modelled after a simulated patient, on a high-tech simulator manikin during simulation training on nursing students' flow experience. The use of high-tech simulator manikins in medical education is common, but their generic appearance can hinder students' engagement and learning.

Methods

The study was conducted using a randomized controlled design with nursing students, comparing simulation scenarios with a manikin wearing a realistic personalized moulage face mask to those with a generic face. The Flow Short Scale was utilized to measure participants' flow experience, encompassing absorption, fluency and anxiety.

Results

Results indicated that the experimental group using the personalized manikin experienced significantly higher levels of overall flow and fluency compared to the control group. No significant differences were observed in absorption and anxiety between the groups.

Discussion

The personalized high-fidelity manikin face could be considered an additional tool for facilitators to enhance learners' engagement and flow in simulation scenarios.

What this study adds:

- Explores impact of personalized moulage masks on nursing simulation.
- Indicates heightened flow experience and fluency in students.
- Recommends personalized face for improved engagement.
- Highlights positive effects of realistic moulages in education.
- Offers insights for enhancing nursing simulation practices.

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Introduction

Complex medical and nursing training scenarios can be practised in a safe and controllable environment using complex high-tech simulator manikins [1]. Those simulator manikins are designed to enhance a physical appearance with functional task alignment [2]. High-tech simulator manikins are used with the intention to increase students' understanding of theoretical concepts through practical application and improve students' engagement and motivation through interactive learning experiences [3]. However the faces of high-tech simulator manikins, like Laerdal's Nursing Anne Simulator, usually appear generic, impersonal and unreal (Picture 1), especially since a person's face carries profound personal information and makes a patient and their case memorable [4]. As a consequence, a generic and lifeless face can negatively influence the students' learning experience [5]. Meerdink and Kahn [6] reported that learners have difficulties engaging with a manikin as if it were a real patient. A lack of realism can act as a mental barrier and prevent participants from fully engaging in the learning scenario [6].

Realism in simulations, in turn, increases the closer a simulation resembles reality, or at least the learners' mental representation of reality [1]; or in other words, to what extent a copy resembles the original [7]. Taking a more conceptual look at realism, Thistlethwaite [8] states that realism is not only based on individual perceptions but combines ontological realism with epistemological constructivism. This means that realism recognizes the existence of an objective (ontological) reality, but also acknowledges that our knowledge and understanding of this reality is constructed by our individual perceptions and cognitive processes (epistemological constructivism). Nestel et al. [9] argue that there are no hard and fast rules about what needs to be real in simulation. Important is clarity about the simulation' purpose, from which deliberate decisions about realism can be made. In fact, realism in purposeful simulations allows learners to perform a task rather than pretending to be performing it. One explanation for the positive impact of realism in simulations is that a flow state can be triggered in the student. Flow is understood as a state of highest concentration and absolute immersion in the current activity [10]. Dimitriadou et al. [11] describe flow as a psychological state characterized by complete absorption and focus during an activity, which plays a crucial role in students' learning effectiveness. Flow positively influences students' cognitive emotional and behavioural engagement. Engagement has been found to mediate the effects of perceived challenge and interaction on student learning. Engagement and concentration in education are closely aligned as they both play vital roles in the learning process. Engagement is essential for effective knowledge acquisition and societal impact. Concentration, on the other hand, is crucial for maintaining focus and absorbing information during educational activities [12]. Students who experience intense concentration and absorption in the simulation activity, known as flow, learn better and are more satisfied overall [13,14]. Flow optimizes mental state, and enhances students' adaptability in simulations [14]. Karwowsky [15] argues that when learners achieve a flow state, they are immersed in learning activities, face challenges proactively, and thus exhibit better learning achievement. Flow has been referred to as the optimal experience when nothing else matters [16,17]. This characterization has led to the belief that flow is a particularly intense – and therefore extreme – experience, which makes immersion a prerequisite to flow [18].

There is some evidence that highly realistic moulages can enhance the students' immersion into a simulation [19]. In addition, Stokes-Parish et al. [20] showed that moulages can increase the realism of learning situations if the given moulages' lifelikeness is ensured. Further, Stokes-Parish et al. [20] stated that the use of highly lifelike moulages impacts students' prioritization and task completion in simulations and conclude that moulages can have an essential role to improve realism and subsequent learner engagement [20,21]. These experiences from using moulages in simulation-based education motivated the authors to produce a lifecast moulage face to give a high-tech simulator manikin an individual face during simulation. Several companies now sell face masks for high-tech simulator manikins and though is little evidence on their influence on learners.

The present study thus aims to examine to what extent a high-tech simulator manikin with a real-to-life moulage face-mask influences learners' flow experience in simulated encounters. We assume that the learners' flow experience will be meaningfully increased when they are faced with a lifelike moulage face mask.

Methods

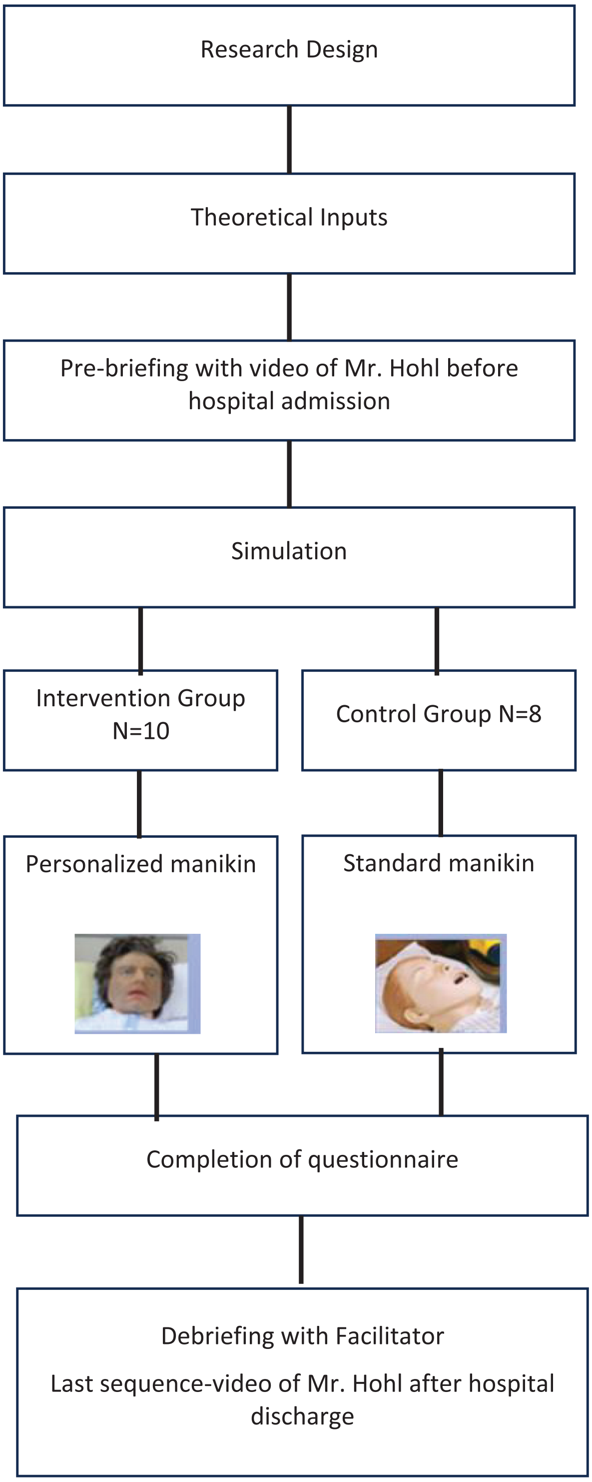
A randomized controlled research design was used. Eligible nursing students were allotted to an experimental group (simulation training *with* manikin wearing a lifelike face mask vs. original generic face) (Figure 1).

Setting and intervention

Eighteen nursing students took part (median age = 23 years), all of whom were in their final year of a 3-year programme. The study was carried out at the Bern College of Higher Education (Berner Bildungszentrum Pflege) in Switzerland. A high-tech simulator manikin was placed in a bed in two separate rooms, one personalized (for the intervention group) and one generic (for the control group). The personalized manikin wore a lifecast facemask that had been previously prepared by a make-up artist from the Institute for Medical Education at the University of Bern. The face mask had been modelled as lifecast from a simulated patient and could be placed precisely onto the nursing manikin (Picture 2). The manikin used was Nursing Anne (Laerdal, Stavanger, NO) which is commonly used in clinical simulation scenarios at the Bern College of Higher Education, meaning its features were well known to learners.

Participants were informed in advance about the procedure but were not told about the intervention. The overarching learning objective of the given scenario was for learners to recognize an in-patient's deteriorating health through targeted examination and monitoring measures, act within the framework of their professional competencies and requirements and coordinate their response systematically.

Figure 1: Research design



A well-thought-out educational sequential simulation event [22] (Figure 1) has been planned by the educators to make the simulation as meaningful as possible.

Before the sequential simulation, all students received theoretical instruction on treating cardiac crises. They learned about the necessary interventions and medications to improve patient outcomes.

Afterwards, in the first sequence, all participants watched a 5-minute video of the patient, Mr. Hohl, speaking to the camera. The middle-aged man, a banker, reiterates his cardiac issues. This scene takes place before his hospital admission for a cardiac check-up. The person portraying Mr. Hohl's role in the videos was the same SP whose face had been cast onto the manikin (in the intervention group). The rationale of using a video was for participants to experience the patient as a person rather than just a case file. The students had previously encountered SPs, but this was the first time they had encountered this particular SP.

In the second sequence, Mr. Hohl is in inpatient care for his check-up. During this stay, he suffers a cardiac crisis. For this 20-minute sequence of deterioration learners were divided into groups of three and assigned to the roles of active leader, active team member or passive observer, in both the intervention and the control group. The active leader is the main person in charge and receives help from the active team member if necessary. The passive observer observes the situation. During the simulation, the students try to perform the necessary nursing interventions according to their roles to avert Mr. Hohl's life-threatening situation. In this sequence, the personalized (intervention group) or generic (control group) simulator manikin was used. Briefing and debriefing were carried out according to Crew Resource Management (CRM) with CRM-trained facilitators. The debriefing focused on improving safety, communication and efficiency within team environments. Spontaneous feedback from the intervention group regarding the facemask was documented and will be reported narratively.

The simulation concludes with a 7-minute video where Mr. Hohl explains his situation after being discharged from hospital, and what kind of life changes he must consider.

Instrument

To measure participants' flow experience, the Flow Short Scale (FSS) was used [23] (see Table 1). The FSS consists of two sub-dimensions 'flow experience' and 'anxiety'. Assessing both flow and anxiety is important as flow-inducing challenges are often accompanied by flow-countering feelings of anxiety or worry.

The flow experience is further divided into two factors 'absorption' and 'fluency', whereas anxiety is assessed with three items. Lavoie et al. [24] state that fluency involves both fluent action and fluent thought and is characterized by the subjective experience of ease and control. They also found that absorption is strongly related to the consequences of flow, such as behavioural intentions and presence. All items were assessed on seven-point Likert scales ranging from 1 (I don't agree) to 7 (I agree).

The FSS was administered in its validated German version (dubbed 'Flow-Kurzskala', FKS) directly after the manikin sequence.

Ethical approval

The necessity of an ethics approval was waived by the responsible ethics commission citing relevant national legislation (BASEC-Nr: Req-2021-00176). This study was conducted in full accordance with standards of good research practice (Helsinki declaration).

Data analysis

All data were analysed using SPSS 27 (IBM Corp., Armonk, NY). We applied non-parametric Mann–Whitney *U* test for independent samples. The probability of error was set at the 5% level for all tests of significance.

Results

Participants assigned to the experimental group experienced significantly higher flow (M = 4.2, standard deviation [SD] = 0.89) compared to participants from the control group (M = 3.1, SD = 0.72; U = 12.5, $p < 0.05$). In addition, participants from the experimental group experienced significantly higher degrees of fluency (M = 3.95; SD = 1.14) compared to the control group (M = 2.59, SD = 0.57; U = 11.5, $p < 0.01$). No further effects were detected.

Spontaneous feedback during the debriefing included remarks such as: 'I was immediately startled because it looked very real. The face even resembled the person in the film, which made it very realistic'. 'I thought the patient I saw in the film looked like the manikin, which made it more real'. 'The fact that it was exactly the face I recognized from the film was very unexpected. But I thought it was very good', and 'because the manikin looked like the patient in the video, I was able to immerse myself better in the simulation' (authors' translations).

Discussion

In this study, nursing students encountered either a high-tech simulator manikin with its original, generic face, or the same manikin, but with a lifecast face modelled from an actor. Learners from the intervention group achieved significantly higher scores on the FSS's general flow dimension as well as its fluency sub-dimension. This implies that using a lifecast facemask on a high-fidelity manikin in simulation training increases students' flow experience. Since a sufficient flow experience can be considered a prerequisite for effective learning, this adds an opportunity for learning facilitators in simulation to support their students' learning [10,15]. No significant differences between the two groups were found for the sub-dimension's absorption and anxiety. We take it that a similar level of absorption indicates that both learner groups, irrespective of the manikin's face, were able to sufficiently engage with the simulation, and that any anxiety experienced was not attributable to the intervention. It could be beneficial when designing a simulation-based learning intervention, to keep flow as a concept in mind. Flow, as a state of full immersion in an activity, has the potential to enhance learning and engagement. Taking a broader view, towards evidence from gaming and serious gaming literature, we learn how it is important to balance task difficulty with player abilities to promote flow: according to Nakamura and Csikszentmihalyi [25], flow occurs when skill level matches the challenge: excessive challenge causes anxiety, while insufficient challenge leads to boredom. In our sequential simulation, tasks were designed to balance students' skills with the activity's challenges, ensuring active engagement. It is still important to bear in mind how interruptions negatively impact flow and fluency, disrupting this balance and reducing engagement.

Our research results provide findings about how a lifecast face positively influences nursing students' flow experience during simulation training. However, some limitations are worth noting. The sample size in this investigation was rather small, while literature confirms [10,15] that a flow experience has a positive impact on student learning, we have no post-intervention performance measure to indicate if the intervention has a relevant impact on students' learning. Though we applied robust statistics to take the limited sample size into account, it is without doubt that further studies are necessary to replicate this intervention on a larger scale and with a more diverse learner population. A follow-up assessment of performance, for example, utilizing a controlled cross-over design, could determine the impact this intervention might have on learning outcomes. We envision an observer checklist documenting performance not only in scenario-specific competencies but also in more general interpersonal competencies like relationship building and prosocial behaviour. An interesting focus of such a follow-up could also be the question of 'how much flow is enough?', as the authors were unable to find any indication on the exact nature of flow, if learners must pass a certain threshold of flow to effectively learn from simulation, or if a further increase of flow further increased learning. In addition, qualitative research should capture students' emotional responses regarding the use of a personalized lifecast face, until then simulation debriefing should be wary of unintended effects on learners.

Lastly, modelling one's own lifecast facemask is no easy task and requires knowledge, skills and experience most simulation experts do not have. In our case, it took a professional make-up artist around 150 hours to develop the mask plus relevant resources for materials. Of course, this mask was made to fit Laerdal's Nursing Anne on its backside for perfect fit, simpler masks that just show a face in the front but are flat on their backside would be easier to produce. These resources must be considered, as individualizing a simulator manikin means that using that mask again with the same learners might be bizarre when introducing that face as a different patient.

Table 1: FSS items [23]

1	I feel just the right amount of challenge
2	My thoughts/activities run fluidly and smoothly
3	I don't notice time passing
4	I have no difficulty concentrating
5	My mind is completely clear
6	I am totally absorbed in what I am doing
7	The right thoughts/movements occur of their own accord
8	I know what I have to do each step of the way
9	I feel that I have everything under control
10	I am completely lost in thought
11	Something important for me was at stake
12	I was not allowed to make mistakes
13	I was worried about failure

Conclusion

Our study found that a personalized manikin increases the students' flow experience during simulation training.

Since flow is associated with immersion [26], which in turn is associated with proper task performance, the personalization of manikins' faces could provide facilitators with an additional option to support learners in simulation. Further studies should explore if the increased flow experience leads to better learning outcomes. This study further suggests educators be mindful of the mechanics underlying simulation and actively model their simulation to maximize learning.

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Declarations

Authors' contributions

All authors contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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Availability of data and materials

Data available on request from the authors.

Ethics approval and consent to participate

The necessity of an ethics approval was waived by the responsible ethics commission citing relevant national legislation (BASEC-Nr: Req-2021-00176). This study was conducted in full accordance with standards of good research practice (Helsinki declaration).

Competing interests

None declared.

References

1. Lioce L, Lopreiato J, Downing D, Chang TP, Robertson JM, Anderson M, Diaz DA, Spain AE, The Terminology and Concepts Working Group. Healthcare simulation dictionary. 2nd edition. Rockville, MD: Agency for Healthcare Research and Quality. 2020. AHRQ Publication No. 20-0019. doi: 10.23970/simulationv2
2. Hamstra SJ, Brydges R, Hatala R, Zendejas B, Cook D. Reconsidering fidelity in simulation-based training. Academic Medicine. 2014;89(3):387–392. doi: 10.1097/ACM.0000000000000130
3. Alsadoon A, Prasad W, Beg A. Using software simulators to enhance the learning of digital logic design for the information technology students. European Journal of Engineering Education. 2017;42(5):533–546. doi: 10.1080/03043797.2016.1196344
4. Franklin R, Adams R. What makes a face memorable? The relationship between face memory and emotional state reasoning. Personality and Individual Differences. 2010;49(1):8–12. doi: 10.1016/j.paid.2010.02.031
5. Shapiro MA. The International Encyclopedia of Communication. June 2008. doi: 10.1002/9781405186407.wbiecp020
6. Meerdink M, Khan J. Comparison of the use of manikins and simulated patients in a multidisciplinary in situ medical simulation program for healthcare professionals in the United Kingdom. Journal of Educational Evaluation for Health Professions. 2021;18:8. doi: 10.3352/jeehp.2021.18.8
7. Diekmann P, Gaba D, Rall M. Deepening the theoretical foundations of patient simulation as social practice. Simulation in Healthcare. 2007;2(3):183–193. doi: 10.1097/SIH.0b013e3180f637f5
8. Thistlethwaite J. When I say … realism. Medical Education. 2015;49(5):459–460. doi: 10.1111/medu.12641
9. Nestel D, Krogh K, Kolbe M. Healthcare simulation education: evidence, theory and practice. In: Nestel D, Kelly, M, Jolly, B, Watson, M, editors. Healthcare simulation education: evidence, theory and practice. 1st edition. Hoboken, NJ: John Wiley & Sons; 2018 p. 23–28.
10. Csikszentmihalyi M. The flow experience and its significance for human psychology. In: Optimal experience: psychological studies of flow in consciousness. Cambridge: Cambridge University Press; 1998.
11. Dimitriadou A, Djafarova N, Turetken O, Verkuyl M, Fernworn A. Challenges in serious game design and development: educators' experiences. Simulation & Gaming. 2021;52(2):132–152. doi: 10.1177/10468781209441
12. Fitzgerald HE, Bruns K, Furco A, Swanson L. The centrality of engagement in higher education. Journal of Higher Education Outreach and Engagement. 2012;16(3):7–28. doi: 10.4324/9781003443353-12
13. Bressler D, Bodzin A. A mixed methods assessments of students' flow experiences during a mobile augmented reality science game. Journal of Computer Assisted Learning. 2013;29:209–226. doi: 10.1111/jcal.12008
14. Samarasinghe D, Barlow M, Lakshika E. Flow-based reinforcement learning. IEEE 2022;10:102247–102265. doi: 10.1109/ACCESS.2022.3209260
15. Karwowski M. The flow of learning. European Journal of Psychology. 2018;14(2):291–295. doi: 10.5964/ejop.v14i2.1660
16. Jackson SA, Csikszentmihalyi M. Flow in sports. Champaign, IL: Human Kinetics. 1999.
17. Csikszentmihalyi M. Flow: the psychology of optimal experience. New York: Harper & Row. 1990.
18. Sanders T, Cairns P. Time perception, immersion and music in videogames. Proceedings of the 24th BCS Interaction Specialist Group Conference; Dundee: British Computer Science; 2010. p.160–167.
19. Mills B, Miles AK, Phan T, Dykstra PMC, Hansen SS, Walsh AS. Investigating the extent realistic moulage impacts on immersion and performance among undergraduate paramedicine students in a simulation-based trauma scenario: a pilot study. Simulation in Healthcare. 2018;13(5):331–340. doi: 10.1097/SIH.0000000000000318
20. Stokes-Parish J, Duvivier R, Jolly BC. Investigating the impact of moulage on simulation engagement – a systematic

review. Nurse Education Today. 2018 May;64:49–55. doi: 10.1016/j.nedt.2018.01.003
21. DCosta S, Zadow G, Reidinger DP, Cox GR, Hudson C, Ingabire A, et al. The impact of moulage on learners' experience in simulation-based education and training: systematic review. BMC Medical Education 2024;24:6. doi: 10.1186/s12909-023-04976-w
22. Kneebone R. Simulation reframed. Advances in Simulation (London). 2016;1:27. doi: 10.1186/s41077-016-0028-8.
23. Rheinberg F, Vollmeyer R, Engeser, S. FKS-Flow-Kurzskala [Verfahrensdokumentation, Fragebogen und Normtabelle]. In: Leibniz-Institut für Psychologie (ZPID) (Hrsg.). Trier: Open Test Archive; 2019. doi: 10.23668/psycharchives.4488
24. Lavoie R, Main K, Stuart-Edwards A. Flow theory: advancing the two-dimensional conceptualization. Motivation and Emotion. 2022;46:38–58.
25. Nakamura J, Csikszentmihalyi M. The concept of flow. Dordrecht: Springer; 2014.
26. Michailidis L, Balaguer-Ballester E, He X. Flow and immersion in video games: the aftermath of a conceptual challenge. Frontiers in Psychology, 2018 Sep 5;9:1682. doi: 10.3389/fpsyg.2018.01682