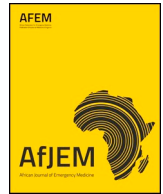




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ORIGINAL ARTICLE

For the students, by the students: Student perceptions of low cost medical moulage in a resource-constrained environment[☆]Andrew William Makkink^{*}, Helen Slabber

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ABSTRACT

Introduction: Simulation-based learning affords participants the opportunity to practice high-acuity, low-incidence situations without risk to the patient. The realism of a simulated scenario is often referred to as fidelity. High levels of fidelity imply high levels of realism. One method of enhancing fidelity is the use of moulage. Commercially available moulage kits and professionally applied moulage are often expensive and therefore not practical in the resource-constrained environment. Cost-effective alternatives are required for the resource-constrained environment.

Methods: Students at a South African university used readily available, low cost materials to apply self-constructed, low cost moulage for a bandaging practical. A cross sectional design used a purpose-designed, validated questionnaire to gather data related to face and content validity of the self-constructed moulage. Frequency analysis formed the cornerstone of Likert-type quantitative data analysis. An open-ended question afforded participants the opportunity to express their own opinions related to the moulage experience.

Results: The results revealed that there was both high face validity and high content validity of the self-constructed moulage. Participants found the activity enjoyable and a generally positive learning experience. The self-constructed moulage was realistic and added to the fidelity of the scenario. Participant confidence was improved and their engagement in the learning activity was enhanced. Participants found the self-constructed, low-cost moulage more realistic than commercial products that they had been exposed to.

Conclusion: The use of low-cost, self-constructed moulage is a feasible and economically viable means of enhancing fidelity within the resource-constrained simulation setting. This technique is not necessarily limited to emergency medical care and can be used in other areas of healthcare simulation.

Introduction

Simulation-based learning involves a substitute experience in which participants are afforded the opportunity to practice high-acuity, low incidence situations without the risk of patient harm [1]. In the healthcare domain, the use of simulation involves reproducing an event that mimics reality using a variety of manikins, human actors or skills trainers [2]. The fidelity of a simulation is often assessed using measures of face validity and content validity. Face validity relates to how realistic the simulated scenario is and content validity relates to the appropriateness of the simulated scenario for the training objectives [3].

One method for enhancing fidelity is the use of moulage [4]. Moulage in the medical education context can be defined as: “the application of make up or other elements in order to add realism to

simulation training by creating realistic looking wounds” [5]. Enhanced fidelity enables the participant to physically visualise and live a more real-world experience, allowing them to better imagine themselves as being in the real world setting [5]. There are a number of companies that specialise in the manufacture of simulation manikins and commercial moulage products. One such commercial set of moulage products is available from Laerdal® and at the time of writing, this retailed for USD2200 [6]. Within a resource-constrained environment the cost of such a moulage kit is usually unaffordable to most institutions within low to middle income countries (LMIC).

Application of make-up and the use of actor-based moulage have been suggested as substitutes to commercial products [3]. Previous studies have described low cost moulage techniques using tools easily accessible to educators and have described how an educator can apply low cost moulage to mimic real wounds [3,7]. None of these studies

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Fig. 1. Examples of low-cost moulage for a simulated bandaging practical.

describe the role of students as the constructors of the moulage and there is very little research related to moulage and the effects that it has on student engagement [8].

This paper examines student perceptions of a self-constructed, low cost moulage technique on improving the fidelity of performing a bandaging skill.

Methods

The study involved a cross-sectional design that used a purpose-designed, validated online questionnaire to gather data. The questionnaire was designed de novo by the principal investigator and reviewed by the second investigator. The process of creating the moulage and the simulated environment is described in Data Supplement One and shown in Figs. 1–3. Participants were studying towards the Bachelor's degree in Emergency Medical Care at the University of Johannesburg who had been involved in a self-constructed moulage

activity.

Potential participants were sent an invitation email that contained an introductory letter and a link to an online questionnaire. The link, when clicked, directed the participant to the questionnaire hosted using the SoGoSurvey® online platform (SoGoSurvey Inc., Herndon, VA, USA, www.sogosurvey.com). Ethical approval was granted by the University of Johannesburg's Faculty of Health Sciences Research Ethics Committee (REC-01-114-2018). All relevant persons at the institution were contacted and each granted permission to use students for data collection. Anonymity was guaranteed by the online platform and it was not possible to trace the participant responses.

A pilot study is one of the recommended techniques for addressing reliability and validity of a questionnaire [9]. The process of performing the pilot study for this research is described in Appendix One. Data from the Likert-type questions were imported from SoGoSurvey® into an Excel® (Microsoft Office, Microsoft Corporation, Redmond, WA) file and analysed descriptively using frequency and percentage responses to



Fig. 2. Examples of low-cost moulage for a simulated bandaging practical.



Fig. 3. Examples of low-cost moulage for a simulated bandaging practical.

contextualise the data. It became apparent during data analysis that some participants had selected more than one response for some of the questions. There were seven such instances and where this was the case, both responses were deleted from the dataset.

An open ended question allowed participants to provide their comments on the moulage activity. Responses were read and reread and analysed using thematic analysis underpinned by a qualitative description strategy. The aim was to provide rich, straight descriptions of the participant experience, providing a description of informants' perceptions in a language that was similar to the informants' own language [10].

Results

First year students from an undergraduate bachelor's degree in emergency medical care at the University of Johannesburg were surveyed for their perceptions of a self-constructed, low-cost moulage activity in which they had been involved. Thirty-four questionnaires were completed on the SoGoSurvey® platform from a total of 55 invitation emails sent. Assuming that all invitation emails had been read, the response rate was 34/55 (62%). We grouped the questions and responses under two broad headings; those related to face validity and those related to content validity. Content validity responses are depicted in [Table 1](#) and face validity responses are depicted in [Table 2](#).

Responses to the open-ended questions generated three themes; the

Table 1
Content validity responses related to self-constructed, low-cost moulage.

Question	Strongly disagree		Disagree		Neutral/unsure		Agree		Strongly agree	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
I enjoyed applying the moulage to myself/my fellow student(s)	0	(0)	0	(0)	0	(0)	9	(27)	24	(73)
I found the moulage material easy to work with and apply	0	(0)	0	(0)	5	(15)	15	(46)	13	(39)
I tried to make the wounds I constructed as realistic as possible	0	(0)	0	(0)	0	(0)	13	(38)	21	(62)
I feel that being involved in the process of simulating a real environment enhanced my learning experience	0	(0)	0	(0)	3	(9)	13	(3)	17	(52)
It was easy for me to immerse myself into the simulated scenario	0	(0)	0	(0)	2	(6)	18	(5)	14	(41)
The use of moulage has improved my confidence at dressing a real wound	0	(0)	0	(0)	2	(6)	22	(65)	10	(29)
It was easy for me to immerse myself into the role of a treating practitioner	0	(0)	0	(0)	1	(3)	21	(62)	12	(35)
This activity was fun	0	(0)	0	(0)	1	(3)	5	(15)	28	(82)
I would recommend using this moulage to enhance the learning of other students.	0	(0)	0	(0)	0	(0)	10	(29)	24	(71)

self-constructed moulage was realistic, the activity was a positive learning experience and participants were required to actively engage in the activity. The three themes that emerged are detailed below and supportive quotes are provided.

The self-constructed moulage had a high level of realism:

- “... you get the shock factor and you see how grotesque the injuries can be...”
- “... the wounds created looked real...”
- “... it also allowed me to easily imagine that wound in a real life environment.”
- “... to allow realistic effects similar to what we see on the road.”

The activity was a positive learning experience:

- “Creating a moulage was a fantastic experience.”
- “I thought the activity was a lot of fun.”

Participants were required to actively engage in the activity:

- “... allowed us to be creative about the wound we create...”
- “... we had to use our imagination a lot.”

Discussion

Participant perceptions of both face and content validity related to self-constructed moulage applied by amateurs were generally positive. Most participants indicated that the self-constructed moulage activity had been a positive experience and that it improved the realism of the scenario.

Participants indicated that their involvement in simulating a real environment enhanced their learning process. The level of apparent authenticity impacts engagement within the artistic domain, similarly, the apparent reality of visual cues within the simulation environment has the potential to affect engagement in the simulation [8]. Participants engaged in the activity by making the wounds that they

constructed as realistic as possible and by having to use their imagination and creativity to construct the moulaged wounds. The levels of realism were confirmed by responses from the open-ended questions where phrases such as ‘grotesque’ and ‘seems like a real wound’ were used.

Participant engagement in simulation is enhanced by factors such as fidelity, authenticity and realism as well as the presence of visual cues, such as moulage [8]. The use of moulage made participants feel more involved in the experience, that it was easy for them to immerse themselves into the simulated scenario and that they felt as if they were in a real emergency situation. Participants were of the opinion that the simulated wounds were realistic and close to what they would have expected in real-life. Participant perceptions were that the self-constructed, low-cost moulage was more realistic than any commercially available products that they may have been exposed to. Participants indicated that the moulage material was easy to work with and apply and that it could easily be used to enhance the reality of any simulated patient's wound.

The experience was perceived as a positive one that was enjoyed by all participants and perceived as fun, themes confirmed in the open-ended responses. The positive perceptions of moulage are echoed in other studies [3]. All participants in our study indicated that they would recommend using this moulage activity as a means of enhancing the learning of other students. Standardised patients have been shown to be more useful in simulation using moulage than manikins [3] and there was a prevailing perception that the use of moulage on a real patient instead of a simulator improved the experience.

This is possibly the first study to explore low-cost, self-constructed moulage within the LMIC environment. Participants had overwhelmingly positive perceptions of this moulage activity. We found high face and content validity for the use of low-cost, self-constructed moulage. This simple, cost-effective moulage technique can easily be implemented in LMIC environments with a minimal cost, without the need for professional make-up artist or expensive, ready-made moulage kits. There is real potential to inexpensively enhance fidelity, realism and authenticity of simulations and in doing so to enhance student

Table 2
Face validity responses related to self-constructed, low-cost moulage.

Question	Strongly disagree		Disagree		Neutral/unsure		Agree		Strongly agree	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
I felt like I was in a real emergency situation	0	(0)	2	(6)	10	(30)	16	(49)	5	(15)
I felt that the moulage in this activity was more realistic than any commercially available products that I have been exposed to	0	(0)	1	(3)	6	(18)	16	(49)	10	(30)
The simulated wounds were realistic and close to what I would expect in real-life	0	(0)	0	(0)	5	(15)	21	(62)	8	(24)
The use of a real patient instead of a manikin or wound simulator improved the experience	0	(0)	0	(0)	0	(0)	12	(35)	22	(65)
The moulaged wounds made me feel more involved in the experience	0	(0)	0	(0)	0	(0)	18	(55)	15	(45)
The moulage that I used can easily be used to enhance the reality of any simulated patient's wound	0	(0)	0	(0)	3	(9)	14	(42)	16	(48)

engagement. This technique is not limited to emergency medical care and can be easily translated into other medical education domains.

The activity did not provide a fully immersive, high fidelity environment but focused on the moulage as the point of departure. This may have resulted in a lower perceived overall fidelity of the activity. The sample was drawn from a small group of participants in a specific programme from one HEI, limiting the generalisability of the results.

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Declaration of competing interest

Neither of the authors have any conflict of interest to declare.

Dissemination of results

In addition to peer-reviewed publication, the intention is to present the results of this study at a conference.

Authors' contributions

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: AWM contributed 80% and HS contributed 20%. Both authors approved the version to be published and agreed to be accountable for all aspects of the work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.afjem.2019.08.003>.

References

- [1] Hayden JK, Smiley RA, Alexander M, Kardong-Edgren S, Jeffries PR. The NCSBN national simulation study: a longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. *J Nurs Regul* 2014;5:S4–40.
- [2] McCaughey CS, Traynor MK. The role of simulation in nurse education. *Nurse Educ Today* 2010;30:827–32. <https://doi.org/10.1016/j.nedt.2010.03.005>.
- [3] Pywell MJ, Evgeniou E, Highway K, Pitt E, Estela CM. High fidelity, low cost moulage as a valid simulation tool to improve burns education. *Burns* 2016;42:844–52. <https://doi.org/10.1016/j.burns.2015.12.013>.
- [4] Smith-Stoner M. Using moulage to enhance educational instruction. *Nurse Educ* 2011;36:21–4. <https://doi.org/10.1097/NNE.0b013e3182001e98>.
- [5] Foot C, Host D, Campher D, Tomczak L, Ziegenfuss M, Cohen J, et al. Moulage in high-fidelity simulation—a chest wall burn escharotomy model for visual realism and as an educational tool. *Simul Healthc* 2008;3:183–7. <https://doi.org/10.1097/SIH.0b013e318184260f>.
- [6] Laerdal. Wound care assessment sets. <https://www.laerdal.com/us/doc/2524/Wound-Care-Assessment-Sets>; 2018, Accessed date: 4 March 2019.
- [7] Swan NA. Burn moulage made easy (and cheap). *J Burn Care Res* 2013;34:215–20. <https://doi.org/10.1097/BCR.0b013e3182721752>.
- [8] Stokes-Parish JB, Duvivier R, Jolly B. Investigating the impact of moulage on simulation engagement — a systematic review. *Nurse Educ Today* 2018;64:49–55. <https://doi.org/10.1016/j.nedt.2018.01.003>.
- [9] Kazi AM, Khalid W. Questionnaire design and validation. *J Pak Med Assoc* 2012;62:514–6.
- [10] Sandelowski M. A matter of taste: evaluating the quality of qualitative research. *Nurs Inq* 2015;22:86–94. <https://doi.org/10.1111/nin.12080>.