Three-Dimensional Technology

Evaluating the Use of Visualisation in Midwifery Education

Downer, Terri; Gray, Michelle; Andersen, Patrea

Published in:
Clinical Simulation in Nursing

DOI:
10.1016/j.ecns.2019.10.008

Published: 01/02/2020

Document Version
Peer reviewed version

Title Page

3D TECHNOLOGY: A PILOT QUALITY IMPROVEMENT INITIATIVE EVALUATING THE USE OF VISUALISATION IN CONTEMPORARY MIDWIFERY EDUCATION

Corresponding Author

Dr Terri Downer, PhD**,** MAdvNurs., GradCertClinEd, RN, RM, SFHEA.

School of Nursing, Midwifery and Paramedicine, University of Sunshine Coast, Queensland.

Ph: +61 7 5456 5765 Email: tdowner@usc.edu.au

Dr Michelle Gray, PhD, Mast Prof Learning, BSc(Hons)Midwifery, RM, RN.

College of Nursing and Midwifery, Charles Darwin University. Casuarina. Darwin.

Ph: +61 435010648 Email: michelle.gray@cdu.edu.au

Dr Patrea Andersen, Phd, MA, BHSc Ng, RN, SFHEA.

Academic Director Simulation and Visualisation and Associate Professor School of Nursing, Midwifery and Paramedicine, University of Sunshine Coast, Queensland.

Ph: +61 7 5456 5899 Email: panders1@usc.edu.au

Abstract (150 words) not in word count

Background: Midwifery learning and teaching resources have remained unchanged for decades**.** At a regional Queensland university, a 3D visualisation artefact was introduced in addition to books, lectures and clinical skills laboratory sessions to enhance students' conceptual understanding of the physiological processes related to the birth of the placenta and haemostasis.

Sample: Fourteen (*n*=14) second year midwifery students volunteered to participate in pilot evaluation.

Method: A mixed method study including a survey and interviews were used to evaluate the 3D artefact and its use.

Results All participants believed the 3D visualisation enabled them to gain a greater depth of understanding about the anatomy and physiology of the uterus and birth of the placenta and understanding of the processes of haemostasis.

Conclusion: Research is needed to assess if students learning and retention of knowledge is improved through using this new technology.

Highlights 2-3

- 3D experiences reinforce student understanding of anatomy and physiology
- Students experience birth of the placenta through 3D visualisation
- All students felt that the 3D immersive experience was beneficial

Key points (1 -2)

- Students value 3D visualisation learning experiences

Key words (3 min)

Visualisation, midwifery, placental birth, CAVE, simulation, Virtual Reality

Title

3D Technology: A pilot quality improvement imitative evaluating the use of visualisation in contemporary midwifery education.

Background

Understanding complex physiological phenomena and achieving conceptual understanding of anatomy from 2D dimensional textbooks alone has long been recognised as challenging for students (Battulga et al., 2012). The Lancet Global Independent Commission for Education of Health Professionals for a new century recommends that in response to changing health needs, institutions should rethink the current approaches to curriculum design and strengthen theoretical and clinical education through interprofessional learning and the inclusion of information technology (IT)-empowered learning (Frenk et al., 2010). The use of immersive virtual reality (IVR) has been well-established in the literature (Butt et al., 2018; Chang et al., 2018) learnings from these works can be adapted to apply to midwifery education. Tiffany and Forneris (2018) believe that VR use in nursing education will increase significantly over the next 5 years to meet student learning outcomes. However, very few quality studies have been completed that consider IVR and how it may improve learning and preparation for practice of midwifery students (Fealy et al., 2019).

The 3D VR Midwifery Learning Artefact

At a regional university in Queensland the use of three-dimensional (3D) visualisation was introduced into the undergraduate midwifery curriculum to complement existing learning and teaching resources. 3D VR applications allow participants to view learning content that

is impossible to see in real life (Guimaraes et al. 2018). Aebersold et al., (2018) found that augmented reality using an iPad or a virtual training app on a mobile devise, assisted students to visualise internal organs and identify anatomical landmarks. Furthermore, multi projection environments such as CAVE Automatic Virtual Environment (CAVE2^{TM}) provide students the opportunity to visualise and immerse themselves in the experience (Guimaraes et al., 2018, Hanson, Andersen & Dunn, 2019). CAVE2™ is a second-generation state-of-the-art environment which provides a 320-degree panoramic 3D virtual environment in which students are immersed generating the sensation of being within a virtual environment. CAVE2™ is a circular room which holds up to 20 people and provides the ideal presentation tool for demonstrating panoramic scenes. Offering unique learning experiences which aim to maximise student learning.

Conceptual understandings of complex health conditions are challenging and require scaffolded learning (Spouse, 1998). An essential part of midwifery education is to facilitate the linking of theory to practice through teaching, discussion, and simulation demonstrations (Way, 2016); however, some events such as physiological involution of the uterus are impossible to recreate and are often articulated through analogies which help the student imagine the processes. It was for these reasons that a 3D artefact was developed by the Visualisation Design Team at the University of the Sunshine Coast under the guidance of midwifery experts. The artefact provides students with a visual representation of the internal anatomical layers of the post birth uterus; uterine muscles, blood vessels, placenta and membranes. The artefact simulates the expulsion of the placenta and membranes and shows the normal physiological response to prevent haemorrhage, demonstrating how the uterine muscles and blood vessels contract to achieve haemostasis, and the uterus involutes as it retracts back into the pelvis over the course of the postnatal period. Figure 1 provides examples of 3D content designed for the midwifery artefact.

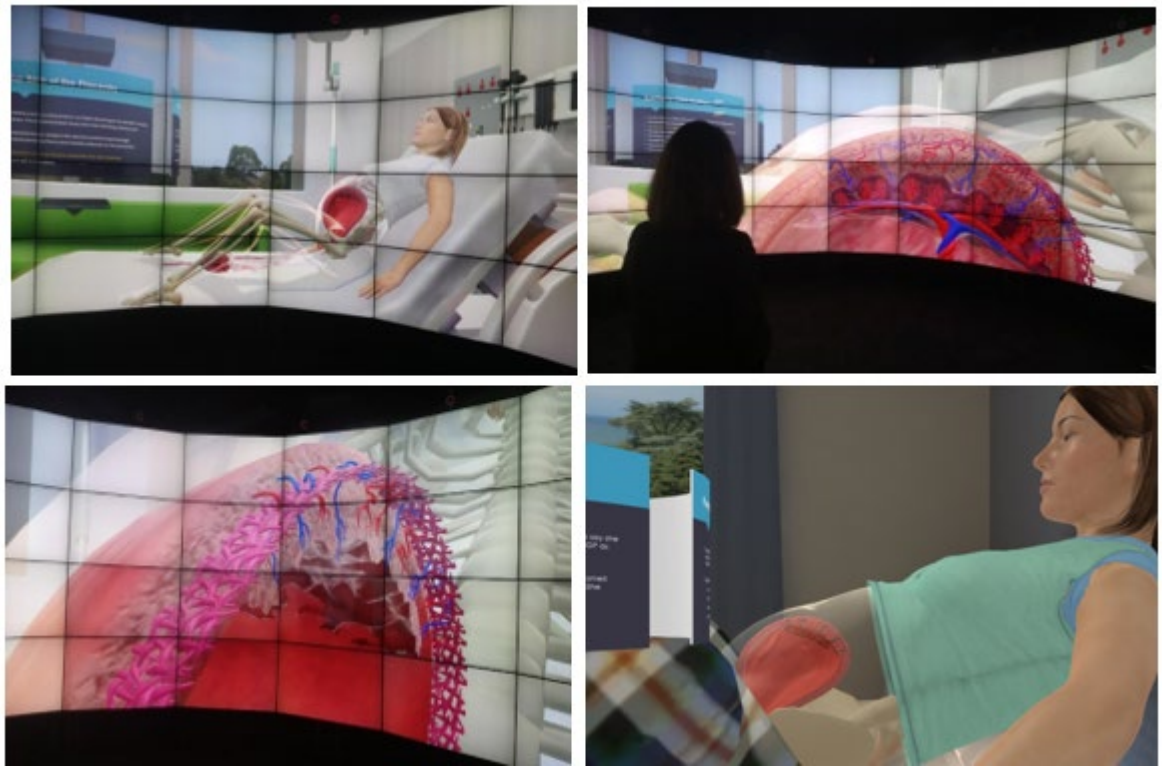

Figure 1. Examples of 3D content designed for the midwifery artefact

This pilot quality improvement initiative was implemented as an extension of the university's teaching evaluation procedures, and was designed to evaluate midwifery student's perception of their learning experience and content delivery addressing the birth of the placenta and membranes, and haemostasis within the CAVE2™ environment.

Sample

Fourteen students enrolled in the Bachelor of Midwifery and dual degree Bachelor of Nursing/Bachelor of Midwifery in their second-year, were offered the opportunity to participate in a 3D visualisation experience in addition to their existing class learning activities. All students as part of their coursework had undertaken recommended readings and participated in a clinical skills lab on the management of a Post-partum haemorrhage.

Ethics

Data was collated as part of a routine evaluation for quality control and as such, ethical approval was not required (National Health and Medical Research Council, 2014, p.3). Ethical considerations of confidentiality and informed consent as described by Burns and

Grove (1993) were applied in this enquiry and ethical principles were maintained throughout the experience. Participants were informed that participation was voluntary and that they would be invited to complete a questionnaire at the end of the 3D VR learning artefact to evaluate their experience. Completion of the survey was deemed as having provided consent. Participants were informed that all data obtained would be anonymous.

Method

Students were oriented to CAVE2™. Wearing 3D glasses students received a fifteen-minute presentation on anatomy, physiology and birth of the placenta. A further 30 minutes was allocated for debriefing using Pendleton's Model (?), and to complete the evaluation questionnaire. Assessment was not associated with the CAVE experience and there were no repercussions should students decide not to complete the evaluation. All students agreed to participate (n=14).

The evaluation tool used comprised of a survey using a 5-point Likert scale (Responses ranged from 1 (Strongly Disagree) to 5 (Strongly Agree)), and three open ended question. The survey gathered student perceptions about how they found the 3D visualisation experience, whether the learning exercise based on the 3D visualisation scenario tested their knowledge about placental birth and involution and if the tutorial has reinforced their understanding of anatomy and physiology. The open-ended questions were designed to provide richness of the data and provide students with opportunities to express their ideas about the learning experience. The questions sort student perceptions about:

- How the use of 3D visualisation influenced their learning when compared to reading learning material from a text book?
- Whether the 3D avatar (the woman) was realistic and why, what aspects good about the woman -why and what could be improved?
- The use of 3D visualisation and the learning experience. Students were also asked if they would like more of these types of learning opportunities?

Results

Quantitative Results.

In this study all (100%) students (*n*=14) felt the 3D immersive experience was beneficial, that they had the opportunity to ask questions, it reinforced course readings, and their understanding anatomy and physiology of the uterus and placenta. Cyber sickness from the experience has previously been reported in the literature (Wahlstrom et al., 2010).In this study 11 out of 14 (78.57%) were not affected by feelings of discomfort reported with cyber sickness. 2 (14%) felt a little discomfort and 1 student (7%) who was prone to motion sickness reported feeling unwell. None (0%) of the students reported finding the images confronting. Table 1 illustrates the experiences as reported by the students.

Table 1: Quantitative Results

		Strongly disagree	**Disagree**	**Unsure**	**Agree**	**Strongly agree**
01	I found the 3D visualisation experience about birth of the placenta to be beneficial.				4 (29%)	10 (71%)
02	The tutorial provided an opportunity to ask questions.				3(21%)	11(79%)
03	The learning exercise based on the 3D visualisation scenario tested my knowledge about placental birth and involution.			1(7%)	5(36%)	8(57%)
04	The 3D visualisation reinforced readings provided on blackboard.				5(38%)	8(62%)
05	The tutorial has reinforced my understanding of anatomy and physiology of the uterus and placenta.				3(21%)	11(79%)
06	The use of 3D technology has helped me to achieve			1(7%)	4(29%)	9(64%)

	this week's learning outcomes.				
07	I found the use of 3D technology made me feel nauseated or unwell.	3(21%)	8(57%)	2(14%)	1(7%)
08	I found the images confronting.	12(86%)	2(14%)		

Qualitative data

In response to question 1 students typically found that visualising the experiences reinforced their readings and made the physiology of birthing the placenta easier to understand, for example:

> *"It was helpful to watch the physiology moving and happening in front of me rather than reading about it and trying to imagine".*
>
> *"The 3D learning gives you a greater understanding through visual representation on how the birthing of the placenta works in stages".*

In response to question 2 where students were asked to comment on the avatar and how she could be improved, they felt that she looked very realistic, some would have liked to have seen the baby on her chest and others would have liked to hear her speak or make noises. One student commented:

> *"She looked normal. When the uterus was contracting you couldn't really see the muscles tightening and shortening of the vessels, you just saw that the entire uterus was smaller when the view pulled out. It would be good to see a front on uterus with the cross section as well to be able to visualise the what it might look like when applying cord traction".*

Evaluating and receiving feedback from the students is very beneficial in developing scenarios using this new technology so that academic staff can continue to improve and develop appropriate resources.

The final open-ended question asked the students to comment on their 3D experience. Without exception all students commented that they would like more, in particular they commented that seeing what was happening on the inside was important to them:

> *"More would be good. In complex or abnormal birth, it would really help to learn the why. And be able to see what's happening on the inside".*
>
> *"It was very good to see what is happening internally in situations we see the external for. I would definitely like to see more of these".*

The results of the evaluation indicate that students found the learning activity to be beneficial and confirmed findings by Foronda et al., (2016) in that the experience reinforced traditional readings and helped students to understand course content. Responses from open-ended student feedback revealed that students were unanimous in their perception that 3D visualisation provided them with a greater depth of understanding about the anatomy and physiology of the uterus and birth of the placenta. Students felt the 3D technology should be expanded and used in other courses throughout their curriculum. The quantitative and qualitative data are presented below.

Limitations

The current study was a pilot quality improvement initiative resulting in a small sample size, and the associated lack of understanding of the use of 3D visualisation for teaching and learning among faculty and students. The researchers also acknowledge that there are limitations associated with questionnaires, in particular the quality and depth of the data obtained (McPeake et al., 2014).

Conclusion and recommendation

This study provided an important evaluation on the of use of 3D visualisation in midwifery education, the results of which will inform future development and use of visualisation in teaching. It highlights student acceptance of technology and shows promise for future developments using 3D immersion in teaching in the future. It is suggested that a randomised study with a larger sample size is undertaken as future research, to assess if students learning and retention of knowledge is improved through using this new technology.

Acknowledgements

Simon Osborn, Christopher Andersen and David Dixon for their expertise in designing the 3D artefact.

References

Aebersold, M. Voepel-Lewis, T Cherara, L.' Weber, M.' Khouri, C, Levine, R, Tait, A.R. (2018). Interactive Anatomy-Augmented Virtual Simulation Training, Clinical Simulation in Nursing, 34-41.

Battulga et al., (2012).The Effectiveness of an Interactive 3-Dimensional Computer Graphics Model for Medical Education, DOI: 10.2196/ijmr.2172. PubMed

Burns, N & Grove, S (1993). The practice of nursing research conduct critique and ulitization. Sanders, USA

Butt, A.L., Kardong-Edgren, S., Ellertson, A., (2018). Using game-based virtual reality with haptics for skill acquisition. Clinical Simulation in Nursing 16, 25–32. https://doi. org/10.1016/j.ecns.2017.09.010.

Chang, C.-Y., Lai, C.-L., Hwang, G.-J., (2018). Trends and research issues of mobile learning studies in nursing education: a review of academic publications from 1971 to 2016. Comput. Educ. 116, 28–48.

Fealy S., Jones D., Hutton A., Graham K., McNeill L., Sweet L., Hazelton M, (2019). The integration of immersive virtual reality in tertiary nursing and midwifery education: A scoping review. Nurse Education Today. 79, 14-19.

Foronda, C, Shubeck, K, Swoboda, S, Hudsen, K, Budhathoki C Sullivan, N & Hu, X (2016). Impact of Virtual Simulation to Teach Concepts of Disaster Triage. Clinical Simulation in Nursing. 12 (4) 137-144.

Frenk, J., Chen, L., Bhutta, Z.A., Cohen, J., Crisp, N., Evans, T., Fineberg H, Garcia, P Ke, Y, Kelley, P……. (2010). Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. Lancet 376 (9756), 1923–1958.

Hanson, J., Andersen, P. & Dunn, P. (2019). Effectiveness of three-dimensional visualisation on undergraduate nursing and midwifery students' knowledge and achievement in pharamacology: A mixed method study. *Nurse Education Today.* Online 30 June 2019 https://doi.org/10.1016/j.nedt.2019.06.008

National Health and Medical Research Council, (2014). National Health and Medical Research Council Ethical Considerations in Quality Assurance and Evaluation Activities Australian Government.

Spouse, J. (1998) Scaffolding student learning in clinical practice. *Nurse Education Today.* 18(4), 259– 266.

Tiffany,J & Forneris S (2018). The forecast for tech usage and growth in nursing education [blog post].Retrieved from https://nlnteq.org/2018/02/07/the-forecast-for-tech-usage-and-growth-in-nursing-education-part-4-of-the-series-the-future-of-technology-in-nursing-education/, Accessed 22nd June 2019.

Wahlstrom M., Aittala, m, Kotilainen, H., Yli-Karhu, T. (2010). CAVE for collaborative patient room design: Analysis with end-user opinion contrasting method, Virtual Reality, 14(3):197-211.

Way, S., (2016). Consistent, quality midwifery care: how midwifery education and the role of the midwife teacher are important contributions to the Lancet Series. Midwifery 33, 1e2. http://dx.doi.org/10.1016/j.midw.2016.01.003.

Zigmont JJ, Kappus LJ, Sudikoff SN. (2011). The 3D model of debriefing: defusing, discovering, and deepening, Semin Perinatol, 35(2):52-58.