Studies in Learning, Evaluation Innovation and Development
http://sleid.cqu.edu.au
8(1), pp. 49–59. October 2011

Immersive virtual reality: Potential use in an undergraduate nursing & midwifery program in Scotland.

S.J.A. McGhee, University of Stirling, stephen.mcghee@stir.ac.uk
P. J. Bradley, University of Stirling, p.j.bradley@stir.ac.uk
A.G. McComish, University of Stirling, sandy.mcomish@stir.ac.uk

Abstract

This article explores some of the tensions involved in introducing simulated learning in to pre-registration nursing and midwifery programmes in one Scottish University. While these tensions may be unique to the United Kingdom it may be useful highlighting them to an international audience. The suggestion being made is that the concept/construct of simulation has been extended from a traditional orientation to incorporate virtual reality learning in general and Immersive Virtual Reality in particular. The authors tentatively promote this development and actively suggest that so doing improves the student learning experience, shifts the balance of education from passive to active learning, and ensures safety of the general public in clinical settings. The authors are keen to explore and develop uses for virtual reality learning in pre-registration nursing and midwifery curricula, whilst cautioning that student skill development involves a careful balance of mastering technical skills and developing human relationships in their application. The challenge for nurse and midwifery educators is to ensure that essential skills development is contextualised within the health and well-being continuum.

Keywords: Simulation, Virtual Reality, Constructivism, Problem Based Learning, Immersion, Workforce Development

This article has been peer-reviewed and accepted for publication in *SLEID*, an international journal of scholarship and research that supports emerging scholars and the development of evidence-based practice in education.

ISSN 1832-2050

Introduction

The origins of immersive virtual reality can be found in the education of professions other than nursing and midwifery (Dede et al., 1996). In the United Kingdom contemporary nursing and midwifery practice and education is closely regulated by the Nursing and Midwifery Council (NMC). Scotland, while operating a health and education system governed by a devolved parliament, is, in nursing and midwifery terms, a participant part of the United Kingdom for the purposes of professional regulation. The most recent standards for nurse education operating in the United Kingdom permits “simulated learning” (NMC, 2010b).

Virtual reality is, in our view, part of simulation and can be utilised in nursing and midwifery programmes within the regulations laid down by the profession. A very specific type of virtual reality used in contemporary approaches to professional education is Immersive Virtual Reality (Kilmon et al., 2010).

Simulation has been a contentious issue in the preparation of the undergraduate nurses and midwives for some time in the UK (Nagle et al., 2008). While there has emerged a body of evidence detailing the pedagogical limitations and opportunities (Harder, 2010), the use of simulation (rather than patient contact mediated learning) has been viewed ambiguously by the professional body amid fears of placing the public at risk and difficulty in ensuring equity of access to and delivery of high quality teaching and learning in approved educational provision.

Intriguingly simulation is not explicitly defined in Nursing and Midwifery Council statements; they prefer the phrase "learning in a simulated practice setting" (NMC, 2007a, 2010b), and is intended to support the development of basic nursing skills in a safe environment early on in the programme before entering clinical practice learning environments (NMC, 2010a). In this context the use of simulation is seen as preparatory for students, "an adjunct to the safe and effective application of clinical skills in direct care in the practice setting and a safe and effective means of supporting learning" (NMC, 2007b, p.). There are clear opportunities for students to begin to acquire the essential skills cluster competencies by use of virtual, simulated or a combination of both these learning methods.

As the students and their clinical experiences mature learning in a simulated environment can be used to introduce students to situations and aspects of practice that may not be available locally and that are particularly challenging or outside the normal scope of the programme (NMC, 2010a). For more senior students then, virtual learning can be used as a replacement for hard to access clinical experience (Dutile et al., 2011).

We would also suggest that this teaching and learning medium may prove to be relevant and beneficial for post registration students of Nursing and Midwifery. A registered practitioner could both develop skill level and maintain competence in rarely utilised nursing actions, processes and skills through exposure to and support in using virtual learning pedagogy.

In taking seriously its duty to safeguard the public, the Nursing and Midwifery Council has been cautious in permitting the accredited use of virtual learning in professional pre-registration courses in the UK. Such has been the delay it was not until 2007 that simulation was permissible in professionally regulated courses (NMC, 2007b)

The on-going debate over regulatory approval for simulation has been resolved in the latest statement of standards for pre-registration nursing (NMC, 2010b) and the Nursing and Midwifery Council now seem disposed more positively towards learners being exposed to a maximum of 300 hours of "clinical training in a simulated practice setting"(NMC, 2010b, p. 67); however, that maximum period of time equates to merely 13% of the mandatory practice hours. Notwithstanding a permitted unrestricted ability to use virtual learning in theoretical rather than practical learning; those 300 hours represents 6.5% of the total pre-registration programme hours a student nurse must accrue to be admitted to the register.

While the profession waited for official sanction the teachers and academics, with the able support of technologists and program designers, have been pushing the

boundaries of virtual learning (Hueng et al., 2010),. Acceptance of simulated practice has been attained whilst the role of such virtual learning is still viewed ambivalently by the Nursing and Midwifery Council.

What is clear to the authors is that the traditional educational methods of clinical skills learning through practicing on high and low fidelity patient models are seen as part of what might better be termed virtual learning environments. What follows here is a case for using immersive virtual reality as a medium for nurse and midwife education.

Immersive Virtual Reality – What is it?

Simulation is an educational technique that is used to replace directly or augment real life situations in an artificial environment, and is currently being integrated into professional healthcare education (Gaba, 2004). Whilst there are a wide variety of experiential activities that can be undertaken in a simulated environment, this paper seeks to outline how developing technology in the form of Immersive Virtual Reality (IVR) can convey and reproduce aspects of clinical practice that would enhance the students educational development (Gaba, 2004; Gabba & Howard, 2001)

Over a number of years, Immersive Virtual Reality (IVR) has been used as a lever to provide educational interaction which mimics the real time situation (Gaddis, 1997; Monahan et al., 2008; Rauch, 2007). Interestingly, this development has occurred at a time when the computer gaming industry has enjoyed global success, and new terms such as “edutainment” have entered academic vocabulary (Rauch, 2007). Ideally, IVR software should allow the user to formulate courses of action within the context of the visual, auditory, and haptic cues (touch) offered by the technology (Huang et al., 2010). Many educators are now recognising the interactive power which IVR possesses, as IVR encourages students to engage with the software so that the simulated environment feels very real (Mantovani et al., 2003).

The educational application of IVR technology allows the student to engage with a three dimensional world which is interactive and immerses the student in a technologically generated clinical practice world. IVR technology encourages interaction with the technological interface which allows for both “visual” and “auditory” feedback (Kilmon et al. 2010). Burdea and Coiffet (2003) offer a definition of IVR as the integration of “immersion, interaction and imagination.” Sherman and Craig (2003) expand on this definition by outlining three sub-sets of immersion: mental, physical and sensory. This particular assertion poses an initial challenge for both technologists and course designers in how they will be able to demonstrate both mental physical and tactile immersion within an IVR environment. (Hanson & Shelton, 2008). Clearly, course designers will not be required to include all three components of “the three I’s”, as not all patient scenarios will require that level of fidelity; therefore, each scenario would have to show an awareness of the level of reality and interaction required. Academics must be able to justify their choice of IVR software with respect to their course learning outcomes and their student’s ability to assimilate the skills required to practice as a registered nurse or midwife (Dickey, 2005). Andreatta et al. (2010) also assert that IVR is an extremely useful tool in that it gives students the opportunity to practice scenarios in a simulated environment which are difficult to stage in real life. Nursing and midwifery are not the only disciplines which are reaping the rewards of IVR technology; the fields of medicine, space, military, police, and fire-fighting

have also taken advantage of its ability to prepare students to recognise and manage critical, life and death situations (Dutile et al., 2011)

Immersive Virtual Reality and Pedagogical Relationships

Whilst there is a body of research which demonstrates clear educational benefits to using virtual reality software (Patrick et al., 2000; Tan et al., 2003), it is clear that all technology used in education must have a sound pedagogical underpinning (Huang, 2002; Huang & Liaw, 2004; Lok et al., 2006).

Constructivism

One theoretical framework which links directly with simulation and IVR is constructivism (Huang et al., 2010) is the educational paradigm which allows students to take an active part in their learning and to construct new ideas, ideas which are potentially linked to previous experiments or experiences (Dewey, 1916). Constructivism is foundational to the work undertaken by Vygotsky. Vygotsky first articulated the need for in depth interaction between students and teachers and named this theory "social constructivism" (Maddux et al., 1997). Numerous research studies have since demonstrated a clear link between a constructivist philosophy and the use of IVR (see Chittaro & Ranon, 2007; Dimitropoulos et al., 2008; John, 2007; Mills & de Araujo,1999; Shih & Yang, 2008). Burdea and Coiffet (2003) go onto to suggest that IVR is an "ideal fit" within social constructivism. Constructivism places importance on the individual learner to create their own knowledge. Course designers therefore must develop the software with the educational needs of the students taken into consideration; IVR facilitates the interaction among students and thus enhances the learning experience. (Ally, 2008; Hein, 1991)

Within the constructivist philosophy there are a number of learning strategies which can be utilised, such as Situated Learning, Role Play, Cooperative/Collaborative Learning, Problem Based Learning, and Creative Learning (Huang et al., 2010). Situated Learning enables students to learn new ideas and concepts in a real situation by actually undertaking a task or skill in a realistic environment (Dewey, 1916). The IVR can be positioned as a useful adjunct to Situated Learning since IVR would allow the students to safely and repeatedly engage in a simulated experience as it happens (Pratt et al., 2005).

In comparison to other forms of simulated practice, IVR gives the students the most opportunity to interact fully with the software and allows for the engagement of all aspects of cognitive functioning just as real time clinical practice does; thus, both experimental and experiential learning can take place within the simulated environment (Huang et al., 2010), and collaboration between learners is maximised. Dimitropoulous et al. (2008) reinforce Vygotsky's assertions around the ability of collaborative work to provide opportunities for the exchange of ideas, for the sharing of experiences, and for the building of knowledge which is directly related to learning. The IVR's ability to integrate multiple users on a screen in avatar format provides great potential for "social scaffolding" in cooperative and collaborative learning (Hodge et al., 2008; Sherman & Craig 2003). This social scaffolding gives the students the opportunity to solve particular problems collaboratively within their group (Huang et al., 2010). The use of a virtual reality learning environment (VRLE) is a strategy which could be used by educators in addition to didactic teaching scenarios. Through their moderation of a VRLE, educators are able to utilise problem-based learning to engage fully with and help

those learners build problem-solving skills free of risk to patients (Moule et al., 2008).These skills could be achieved by setting a particular problem to a group of learners and allowing them to work through the problem with limited guidance from the course moderator; in addition to this advantage, the greatest benefit of the VRLE is the software's ability to react to the responses of the student. This type of individuality has huge educational benefit to learners, and the VRLE's ability to provide timely, structured feedback gives much greater opportunity for hands-on learning than a standard didactic lecture (Brenton et al., 2007).

Wrestling and Wrangling with the Barriers: A Collaborative Solution?

There is, in our opinion, no doubt that IVR has the potential to allow nursing and midwifery students to benefit from experiential learning scenarios that are potentially authentic (Walsh, 2010). Although the literature clearly suggests IVR's educational benefits (Hueng et al., 2010) Schools of Nursing & Midwifery have been reluctant to commit their very limited resources to full scale adoption (Dutile et al., 2011).

The sector has been wresting and wrangling with competing demands for resources within the context of a reduction in the numbers of nursing and midwifery student places on offer within Scottish Universities (Buchan & Seccomb 2009). Additional problems that have affected IVR's widespread integration into the undergraduate nursing curriculum has been the costs involved in creating IVR software and the lengthy delay in getting these types of software into the simulation laboratories for student use (Walsh, 2010).

A Proposed Solution

In order to develop an IVR resource that will enhance the educational and student experience: One School of Nursing , Midwifery and Health is working collaboratively with Skills 2 Learn an award winning company who specialise in developing e-learning , virtual reality and creative multi-media that will allow our educational interaction to be taken to the next level. This type of partnership working addresses the delay between identifying an educational need and quickly providing a virtual tool. Currently one patient scenario has been completed. This interactive scenario is based on a real life situation of a 36-week antenatal assessment. Combining virtual reality and multimedia the user can navigate around the hospital, interact with patients and carry out appropriate tests with the correct instruments (Figures 1, 2 & 3). Further areas for development have been mapped against the NMC Essential Skills Clusters ESCs (NMC, 2010b).

Moreover, the authors are currently developing interactive scenarios that will develop practitioner's numeracy, communication and acute assessment skills.

Whilst the use of virtual reality resources in nursing and midwifery is not new (Hodson & Carlton, 1996), many Universities accredited to provide NMC approved programmes have struggled with cost, competence, and lengthy development timelines to fully engage with IVR. The authors firmly believe that the creation of an educational development consortium with private sector partners is a way forward and would allow for the effective and timely development of a range of IVR resources that could be used within Nursing & Midwifery undergraduate programmes and beyond.

Figure 1 **Displays the abdomen and a range of clinical skills that the student midwife can undertake.**

Figure 2 **Outlines the position of the fetal head according to the term of pregnancy.**

Figure 3 **Shows a picture of the virtual ward area to be used in relation to developing basic nursing skills.**

Discussion

The use of Immersive Virtual Reality in nurse and midwifery education in the United Kingdom appears, to have suffered from NMC equivocation (Le Flore et al., 2007, NMC, 2007a, 2007b) and from a reputation born in simulated learning that relied heavily upon the technical capabilities of the early simulation resources that were available for use (Dutile et al., 2011).

As simulation mannequins became increasingly more high fidelity and able to reproduce physiological responses to student interaction the nature of simulated learning naturally became more complex and the repertoire of nursing skills that lent themselves to simulation increased. As such nursing and midwifery students who participated in these sessions became very skilled in responding, through repetitive rehearsals, with proper responses to complex but naturally occurring progressions in clinical conditions and dealing with predictably typical escalations to clinical scenarios.

Abnormal or unpredictable simulated scenarios were less easy to expose student to in virtual environments (Nagle et al., 2008). Learners subsequently were inhibited in their skills development and knowledge base by this limitation. For example, while students could track and respond to the clinical signs and symptoms of a cardiac patient as they progress towards cardiac arrest they could not practise responding to the human idiosyncrasies displayed by a person in cardiac distress. No matter how high fidelity the model being used, the variables of human behaviour were too wide to mimic in traditional simulation. Similarly, while students could master the skills and map the anatomy of the digestive track in passing NG tubes in the skills lab, the additional complication of altered

physiology and a person suffering from anxiety disorder were until now impossible to recreate in the class room.

In short simulation that relied upon technology was imperfect as a proving ground for caring for people as the technology disallowed the human responses to the impact of nursing and midwifery practice. Students, therefore, while acquiring technical ability and gaining resource familiarity learned nothing about the interactions with patients and were unpractised in the human aspects of the tasks.

Nurses and midwives need to both acquire competence in delivering skills and require factual knowledge to support that practice. Of equal importance, however, are the interpersonal skills crucial in establishing professional helpful relationships.

The new versions of IVR go some way towards recreating reality as we replicate the range of human responses that complicate the nursing procedures and processes and also refine our evidence base for nursing pedagogy.

Conclusion

Where traditional approaches to simulation and use of virtual reality can be of further benefit to student nurse, midwives, and registered practitioners is in the provision of an environment where learners can take control of their own learning while safeguarding the public. They will become both more confident in their ability as continuity of support is ensured, and develop skills more safely in response to consistent and reliable feedback. In a recent study looking at clinical learning allocations, Roxburgh et al. (2011) found that elongated exposure to a single source of feedback can have a beneficial effect on student self-efficacy and attainment of competence in clinical skills. Exposing students to IVR it can be argued replicates those learning conditions.

This development is worthy of further study.

Acknowledgements

Acknowledgement to Mr Brijesh Singh, E-Learning Development Manager for Skills 2 Learn for permission to use the program’s screen shots.

References

Ally, H. (2008). Foundations of educational theory for online learning. In: T. Anderson (Ed.). *Theory and practice of online learning*. Edmonton, AB: AU Press.

Andreatta, P.B., Maslowski, S.P., Woojin, S., Michael Marsh, M.S., Theodore, H., Stern, S., & Frankel, M.D. (2010). Virtual reality triage training provides a viable solution for disaster- preparedness. *Academic Emergency Medicine 17,* 870-876

Brenton, S.A., Hernandez, J., Bello, F., Strutton, P., Purkayastha, S., Firth, T., & Darzi, A. (2007). Using multimedia and Web3D to enhance anatomy teaching. *Computers & Education, 49,* 32-53

Buchan,J., & Seccombe, I. (2009). *Difficult times: Difficult choices: the UK nursing labour market review.* London, UK: RCN Publishing.

Burdea, G.C., & Coiffet, P. (2003) *Virtual reality technology* (2ns ed.).New York, NY: John Wiley & Sons.

Chittaro, L., & Ranon, R. (2007). Web3D technologies in learning, education and training: motivations, issues, opportunities. *Computers & Education*, 49, 3-18.

Dede, C, Salzman, M.C., & Lofton, B. (1996). Science – Space; virtual realities for learning complex and abstract scientific concepts. Paper presented at *Virtual Reality Annual International Symposium*. Sante Clara,CA.

Dewey, J. (1916). *Democracy and education* (1966 ed.). New York, NY: The Free Press.

Dickey, M.D. (2005). Brave (new interactive) worlds: a review of the design affordances and constraints of two 3D virtual worlds as interactive learning environments. *Interactive Learning Environments, 13*(1-2), 121-137

Dimitropoulos, K., Manitsaris, A., & Mavridis, I. (2008) .Building virtual reality environments for distance education on the web: A case study in medical education. *International Journal of Social Science, 2*(1), 62-70.

Dutile. C., Wright, N., & Beauchesne, M. (2011). Virtual clinical education: Going the full distance in nursing education. *Newborn & Infant Nursing Reviews*, 11, 43-48.

Gabba, D.M. (2004) .The future vision of simulation in health care. *Quality Safe Health Care, 13*(1), 3-12.

Gabba, D.M., & Howard, L.E. (2001). Structural and organizational issues in patient safety: a comparison of health-care and other high-hazard industries. *California Management Review*, 43, 83-102.

Gaddis, T. (1997). What is virtual reality?. Paper presented at the *League for Innovation Conference on Information Technology*, Atlanta, GA.

Harder, B.N. (2010) .Use of simulation in teaching and learning in health science: a systematic review. *Journal of Nurse Education, 49,* 23-28.

Hanson, K., & Shelton, B.E. (2008). Design and development of virtual reality: analysis of challenges faced by educators. *Educational Technology & Society, 11*(1), 118-131.

Hein, G. (1991). Constructivist learning theory. Presented at *CECA (International Committee of Museum Educators Conference*, October 15 1991. Available at: www.exploratoriu.edu/IFI/resources/constructivistlearninghtml. [Accessed August 3, 2012.]

Hodge, E.M., Tabrizi, M.H.N., Farwell, M.A., & Wuensch, K.L. (2008). Virtual reality classroom strategies for creating a social presence. *International Journal of Social Science, 2*(2), 105-109.

Hodson Carlton, K.E. (1996). Implications for nursing education: a virtual Mrs Chase and cyberspace learning. *Computers in Nursing, 14*(3), 148-149.

Huang, H. (2002). Towards constructivism for adult learners in online learning environments. *British Journal of Educational Technology, 31*(1), 27-38.

Huang, H.M., & Liaw, S.S. (2004). Guiding distance educators in building web-based instructors. *International Journal of Instructional Media, 31*(2), 1-12.

Huang, M.H., Rauch, U., & Liaw, S.S. (2010) .Investigating learner's attitudes toward virtual learning environments: Based on a constructivist approach. *Computers & Education, 55,* 1171-1182.

John, N.W. (2007). The impact of Web3D technologies on medical education and training. *Computers & Education, 49,* 93-109.

Kilmon, C.A., Brown, L., Ghosh, S., & Mikitiuk, A. (2010). Immersive virtual reality simulations in nurse education. *Nurse Educational Perspectives, 31(*15), 314-317.

LeFlore, J.L., Anderson, M., Michael, J.L., Engle, W., & Anderson, J. (2007). Comparison of self-directed learning versus instructor-modelled learning during a simulated clinical experience. *Simulation in Healthcare, 2*(3), 170-177.

Lok, B., Ferdig, R. E., Raij, A., Johnsen, K., Dickerson, R., & Coutts, J. (2006). Applying virtual reality in medical communication education: current findings and potential teaching and learning benefits of immersive virtual reality patients. *Virtual Reality, 10*(3-4), 185-195.

Maddux, C.D., Johnson, D.L., & Willis, J.W. (1997). *Educational computing, Learning with tomorrow's technologies* (2nd ed.).Needham Height, MA: Allyn & Bacon.

Mantovani, F., Castelnuovo, G., Gaggioli, A., & Riva, G. (2003). VR learning: Potential and challenges for the use of 3D environments in education and training. In G. Riva & C. Galimberti (Eds.), *Towards cyber psychology: Mind, cognitions and society in the internet age*. Amsterdam, Netherlands: IOS Press.

Mills, S., Araujo, M.M.T. (1999). Learning through virtual reality: a preliminary investigation. *Interacting with computers, 11,*453-462.

Monaghan, T., McArdle, G., & Bartolotto, M. (2008). Virtual reality for collaborative e-learning. *Computers & Education, 50,* 1339-1353.

Moule, P., Wilford, A., Sales, R., & Lockyer, L. (2008). Student experiences and mentor views of the use of simulation for learning. *Nurse Education Today, 28,* 790-797.

Nagle, B., McHale, M., Alexander, G., & French, B. (2008). Incorporating scenario-based simulation into hospital nursing education program. *Journal of Continuing Education, 40,*18-25.

Nursing and Midwifery Council ((NMC). (2007a). Guidance for the introduction of the Essential Skills Clusters for Pre-registration Nursing programmes**.**) Annexe 1 to NMC Circular 07/2007, NMC, London

Nursing and Midwifery Council (NMC). (2007b). *Supporting direct care through simulated practice learning in the pre-registration nursing programme. Circular35/2007*. London, Uk: Author.

Nursing and Midwifery Council (NMC). (2010a). Advice and supporting information for implementing NMC standards for pre-registration nursing education. London, UK: Author.

Nursing and Midwifery Council (2010b*) Standards for pre-registration nursing education.* London, UK: Author.

Patrick, E., Cosgrove, D., Slavkovie, A., Rode, J., Verratti, T., & Chiselko, G. (2000). Using a large projection screen as an alternative to head-mounted displays for virtual enviroments.*CHI 2000.* Retrieved from http://citeserx.ist.psu.edu/viewdoc/download?

Pratt, D.R., Zyda, M., & Kelleher, K. (1995). Virtual reality: In the mind of the beholder. *IEEE Computer Society, 28*(7), 17-19.

Rauch, U. (2007) .Who owns this space anyway? The arts 3D VL Metaverse as a network of imagination. In *Proceedings of ED-MEDIA, 2007,*(pp. 4249-4253).

Roxburgh, M., Bradley, P., & Lauder, W. (2011). *The development, implementation and evaluation of demonstration projects of new approaches to providing practice placements in the pre-registration nursing programmes: Contemporising practice placements for undergraduate student nurses: Are "hub and spoke" models the future?*. Edinburgh, Scotland: NHS Education Scotland,

Sherman, W.R., & Craig, A.B. (2003) .*Understanding virtual reality*. New York, NY: Morgan Kaufmann Publishers.

Shin, Y.C., & Yang, M.T. (2008). A collaborative virtual environment for situated language learning using VEC3D. *Educational Technology & Society, 11*(1), 56-58.

Tan, D.S., Gergle, D., Scupelli, P.G., & Pausch, R. (2003). With similar visual angles, larger displays improve spatial performance, *CHI 2003, 5*(1), 217-224.

Walsh, M. (2010). Narrative pedagogy and simulation: Future directions for nursing education. *Nurse Education in Practice,* 10, 1006 1-4.