Designing a Virtual Health Faculty Hub

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In this paper, we discuss the design of a 360-degree virtual environment experience for Health School students to explore seven university health disciplines within the School of Clinical Science. This teaching approach uses the Seekbeak 360-degree online platform to create a virtual environment and a rhizomatic learning pedagogy to encourage participatory and negotiated community engagement. Participants engage with a 360-degree virtual scene that allows exploration of each of the health disciplines. This allows the student to experience core competencies and example environments for each discipline via a centralised single hub. Informed by a Design-Based Research methodology we discuss the first prototype stage of the virtual health hub that has been developed using Seekbeak. The virtual health faculty hub aims to create an inexpensive mobile BYOD immersive environment for 578 first year Health School students to explore and experience the health teams with whom they will collaborate in real world situations upon graduation.

Keywords: Virtual Reality, Authentic Learning, Interdisciplinary, Design-Based Research, Mobile Learning

Introduction

Providing interprofessional understanding within a virtual environment ideally leads to an improved interdisciplinary understanding that removes the barrier of professionals in silos and breaks the barrier of physical dispersion of health disciplines across multiple university campuses. The goal of the project design is for students from each cohort to be able to authentically explore and critique the unique elements of "what is" health school via a virtual world. Currently, there is limited understanding between one profession and another, which are represented by separate departments at the University. For example, Paramedics do not have an in-depth understanding of the complexity and skill set of midwifery and vice versa. The hub is designed to allow a detailed and in-depth exploration and encourage participants to adopt a mind-set of unrestricted and creative inquiry into what each discipline offers by way of an educational and professional community model.

The current approach within the university is to promote study of core semester one subjects that all health school students take together. Whilst here each discipline connects, there is no sharing of knowledge outside of that core subject to allow interprofessional understanding or knowledge. In essence, the students are ignorant of the intersection between the seven discipline educational and career pathways. This concept of education is centred in local siloed knowledge economy pedagogies (Farrell, 2001) that assume that the learning process should happen organically in isolation with a defined beginning and curriculum based end goal.

Knowledge seekers in cutting-edge health care fields are increasingly finding that ongoing appraisal of new developments is most effectively achieved through the participatory and negotiated experience of rhizomatic or decentralised community engagement through involvement in multiple global communities where new information is being assimilated and tested (Otterness, 2017). Rhizomatic learning acknowledges that learners come from different contexts, that they need different core capabilities, and it can never be presumed as to what those capabilities are. Learning is a complex process of sense-making to which each learner brings their own context and has their own needs. It overturns conventional notions of instructional pedagogy by positing that "the community is the curriculum"; that learning is not designed around content but is instead a social process in which we learn with and from each other (Cormier, 2008). Rhizomatic learning draws upon and extends the

concepts developed in social constructivism and connectivism. We chose Rhizomatic learning as the underpinning pedagogy for the design of the virtual health hub. Thus the development of the immersive virtual health faculty hub is informed by rhizomatic learning principles and founded upon a design-based research (DBR) methodology (Bannan, Cook, & Pachler, 2015; McKenney & Reeves, 2012) that follows four key stages: analysis and exploration, development of prototype, evaluation and redesign, and dissemination. In the following sections of this paper we outline the initial exploration and prototyping phases of the DBR project.

Literature review

The first stage of the project is an exploration of relevant literature to guide the identification of design principles for the project and the initial prototyping.

Mobile Virtual Reality

We chose mobile VR as the enabling technology for the project development because of the ubiquity of mobile device ownership (International Telecommunication Union, 2016), the ability of mobile VR to create and share authentic learning environments (Burden & Kearney, 2016), the low cost of development (Amer & Peralez, 2014), and low technical expertise required for development (Dolan & Parets, 2016).

The design principles (DP) we identified through the literature on designing authentic mobile learning and scaffolding innovative pedagogies, explored in Cochrane, Cook, et al., (2017), are summarised below and were used to guide the development and implementation of the project:

- DP1: Basing the project within a design-based research methodology (Bannan et al., 2015; Cook & Santos, 2016)
- DP2: Supporting the project through the establishment of a community of practice (Cochrane, 2014; Cochrane & Narayan, 2016)
- DP3: Using heutagogy (student-determined learning) as a guiding pedagogical framework (Blaschke & Hase, 2015; Hase, 2014)
- DP4: Designing around the authentic use of mobile devices and VR (Burden & Kearney, 2016; Cochrane & Narayan, 2017; Kearney, Schuck, Burden, & Aubusson, 2012)
- DP5: Integrate collaboration and team-work into the project activities (Kearney et al., 2012; OECD, 2015)

Simulation is a key technique utilised in most health care educational environments (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014; Pike & O'Donnell, 2010), however the use of mobile virtual reality to enhance simulation educational environments is relatively new (Birt, Moore, & Cowling, 2017; Hussein & Natterdal, 2015). Our main restriction was budget, however this also led to the development of an agile BYOD approach as a model for learner-generated content and contexts (Cochrane, Cook, et al., 2017), informed by DP3 – heutagogy or student-determined learning.

DBR methodology for mobile VR development

The project has developed through various experiences and iterations (Cochrane, Cook, Aiello, Harrison, & Aguayo, 2016; Cochrane, Stretton, et al., 2017), from which we have developed a Design-Based Research methodology and established a design team to guide the development of mobile virtual reality for health education (Cochrane, Cook, et al., 2017). Building upon the work of Bannan, Cook and Pachler (2015), Cook and Santos (2016) argue that DBR is good fit for designing and researching mobile learning environments.

DBR provides a structured approach to educational design that is concerned with generating research outcomes that are potentially transferable to contexts beyond that of the original research domain, and therefore has the potential to impact teaching and learning practice in a wider sphere than a simple case study approach (Amiel & Reeves, 2008; Reeves, Herrington, & Oliver, 2005). We are primarily concerned with the first two stages of design based research outlined by McKenney and Reeves (2012) in this paper: analysis and exploration, and development of a prototype intervention.

Analysis and exploration
The first stage of a design based research project is analysis of the need for the research and exploration of existing literature relevant to the proposed research. The previous sections of this paper overview the research context and drivers for the research. This is then followed by a review of pre-existing literature to establish initial design principles to inform the development and prototyping stage.

Development and prototyping
A key element in mobile VR development is the choice of tools to support and enable the development process (Hussein & Natterdal, 2015). These tools comprise a collection of interdependent elements that can be described as an 'ecology of resources' (EOR) (Cormier, 2008), from which learner centric environments can be designed (Cochrane, Antonczak, & Guinibert, 2014; Luckin, 2008; Pachler, Bachmair, & Cook, 2010).

Methodology

The context of the project is a University Health School with seven distinct health departments: Paramedicine, Nursing, Physiotherapy, Occupational therapy, Midwifery, Oral health, and Podiatry.

Research Questions

The main research question for the project is: How can we use mobile VR to design an enriched and authentic environment for health students to gain an understanding of the seven related health disciplines offered at the University?

Participants

Participants in the project included the three year-based student cohorts, and the project design and research team. We limited the scope of the prototype to three of the seven health disciplines: Paramedicine, Physiotherapy, and Nursing. Ethics consent was applied for and granted through the university's ethics committee.

Project Design Team

Table 1: Design-Based Research Team

DBR Collaborators	**MESH360 Project Design Team**				
	Paramedic Lecturers	***Physio Lecturers***	***Nursing Lecturers***	***MMR Development Team***	***Academic Advisors***
Key responsibility	Discipline context experts	Discipline context experts	Discipline context experts	Technology implementation advice	Educational technology foundations

As shown in Table 1 the research project involved the collaboration of four teams, each with specific expertise required to design and develop the theoretical and practical elements of the project. These included five teams based at the University: three discipline expert teams (Paramedic, Physiotherapy, and Nursing lecturers); academic advisors as educational technology experts; and an MMR development team providing MMR platform choice and integration advise.

Design of Prototype

In this section we outline the key steps in the development of our initial mobile VR Health Hub prototype.

Design Principles
The design principles identified in the literature review provided a foundation upon which to choose an appropriate ecology of resources to support and implement the project.

Mobile VR Ecology Of Resources
The ecology of resources has six core elements: a project collaborative hub, enabled by BYOD devices and low-cost HMD technologies, simple mobile VR content creation tools, a cloud-based VR content sharing platform utilizing Seekbeak for interactive panoramas and YouTube 360 for immersive video, and user-centric content sharing platforms. Example tools utilised for each of the six core EOR elements are illustrated in figure1. These are not exhaustive, and we recognize that the selection of actual tools used may well change and develop over the life-span of the VR hub project.

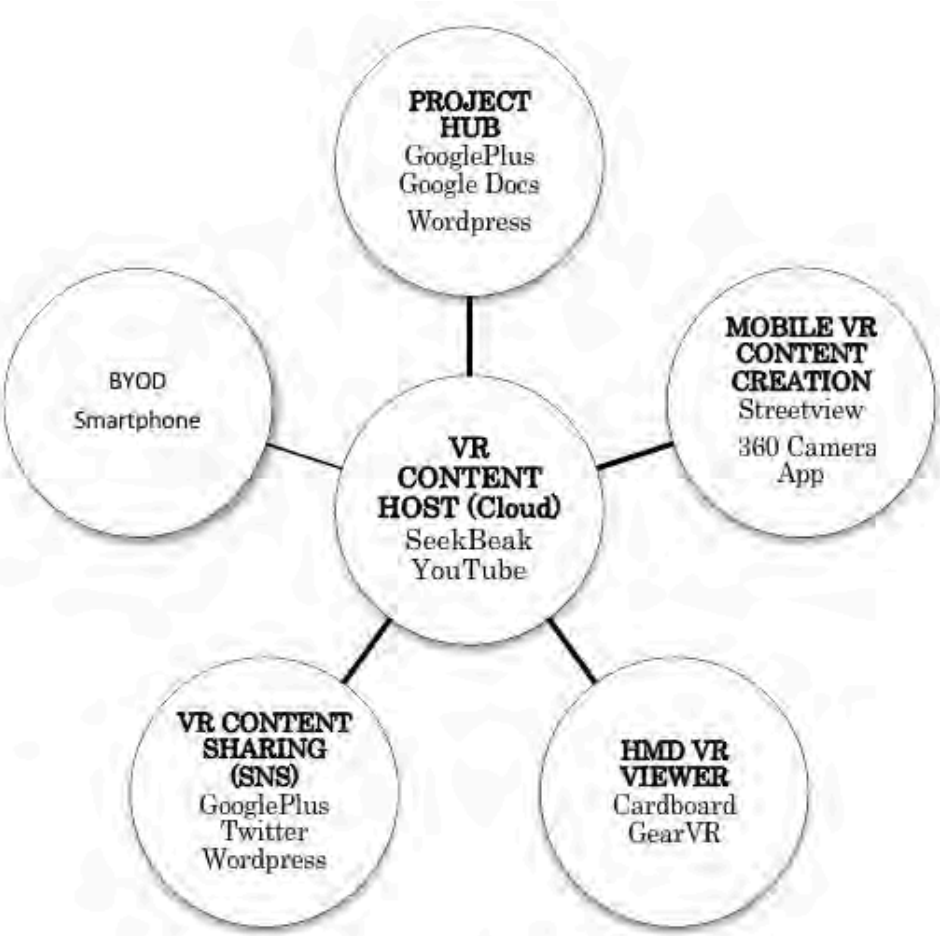

Figure 1: Mobile Virtual Reality Ecology Of Resources

Development Workshop
The research team were invited to a collaborative day-long workshop to introduce the ecology of resources and in particular to provide a peer-support group in the use of the development platform, SeekBeak. By the end of the workshop the team had developed the basic structure for three interlinked VR scenarios to introduce students to the disciplines of Paramedicine, Nursing, and Physiotherapy, as well as a basic storyboard for an interprofessional handover VR simulation.

SeekBeak Prototype
SeekBeak proved to be a simple and agile development and sharing platform for the mobile VR project. Brainstorms between the research team members led to the initial concept map of the elements of the prototype mobile VR Health Hub shown in Figure 2, and screenshots of the three prototype sections that were subsequently developed are shown in Figures 3-6. Key elements of the VR health discipline hub included a central VR hub entry page, with links to each of the seven health disciplines, and a planned interdisciplinary patient handover scenario illustrating the interaction between the seven health teams in real life. Each of the seven disciplines would feature links to further modes of resources for students and community building such as: Google Plus Communities, YouTube Channels, Twitter hashtag searches, expert and team blogs. The initial prototype of the VR Health Hub involved the development of resources for three of the disciplines: Paramedicine, Nursing, and Physiotherapy.

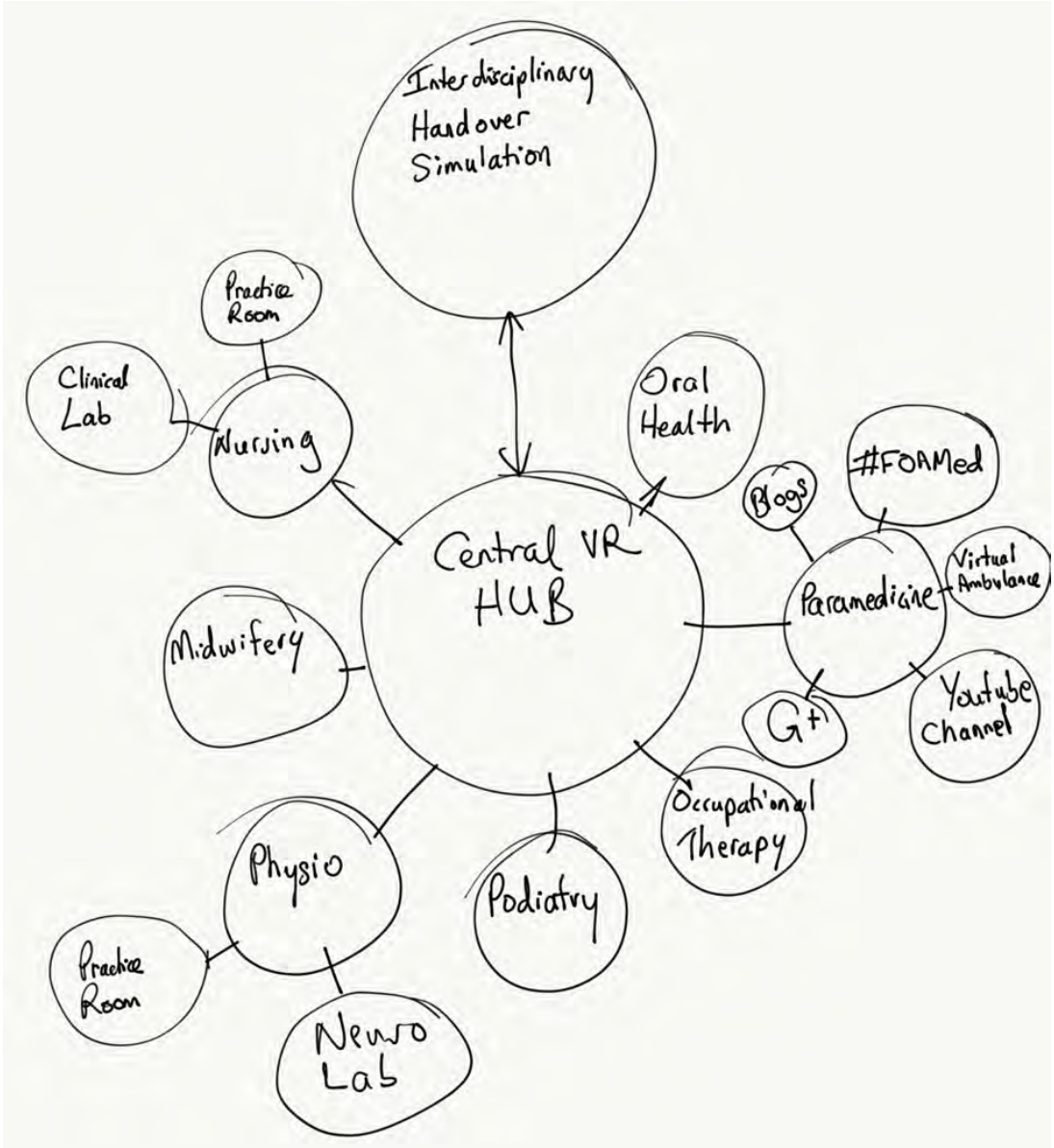

Figure 2: Mobile VR Health Hug concept map.

The link to the entry page of the VR Health discipline hub can be found at:
https://seekbeak.com/v/GYbjNx9p1A7

The screenshots (Figures 3-5) illustrate the use of visual hotspots for VR navigation, thumbnails of the VR environment sections, and basic user view statistics. Using SeekBeak provided device independent interface that could be viewed in any web browser on any device, with the option of a VR mode for display on a HMD when using a smartphone. Navigation of the VR environment in SeekBeak is determined by the display device – either mouse-based or touch-based on PCs or tablets, and gaze-based on smartphones when in VR mode for use in HMD (Head-Mounted Displays).

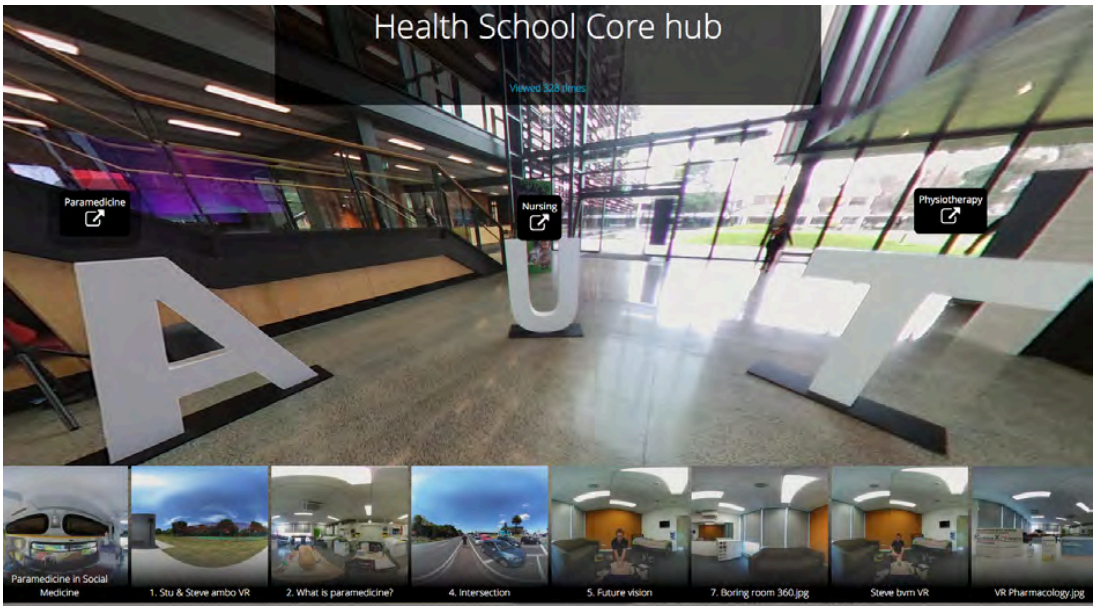

Figure 3: Entry page of mobile VR Health Hub

Figure 3 shows the main entry page of the virtual Health School Hub. Thumbnails at the bottom of the scene provide previews of the linked VR environments.

Figure 4: Paramedicine main page of mobile VR Health Hub

The Paramedicine environment (Figure 4, linked via a hotspot from within Figure 3) depicts a both a simulation suite and the back of an ambulance. We are able to provide the student breakdowns of our equipment and 360 videos of example practice simulations. Embedded within the VR scenes links are to key partner suppliers and manufacturers of equipment and medical supplies informational PDF's or websites. This allows the student to have a clear understanding of equipment placement in the ambulances they will be in for their clinical placements. The hub allows the student to see authentic examples of equipment and see how they fit in the context of the ambulance and paramedic practice.

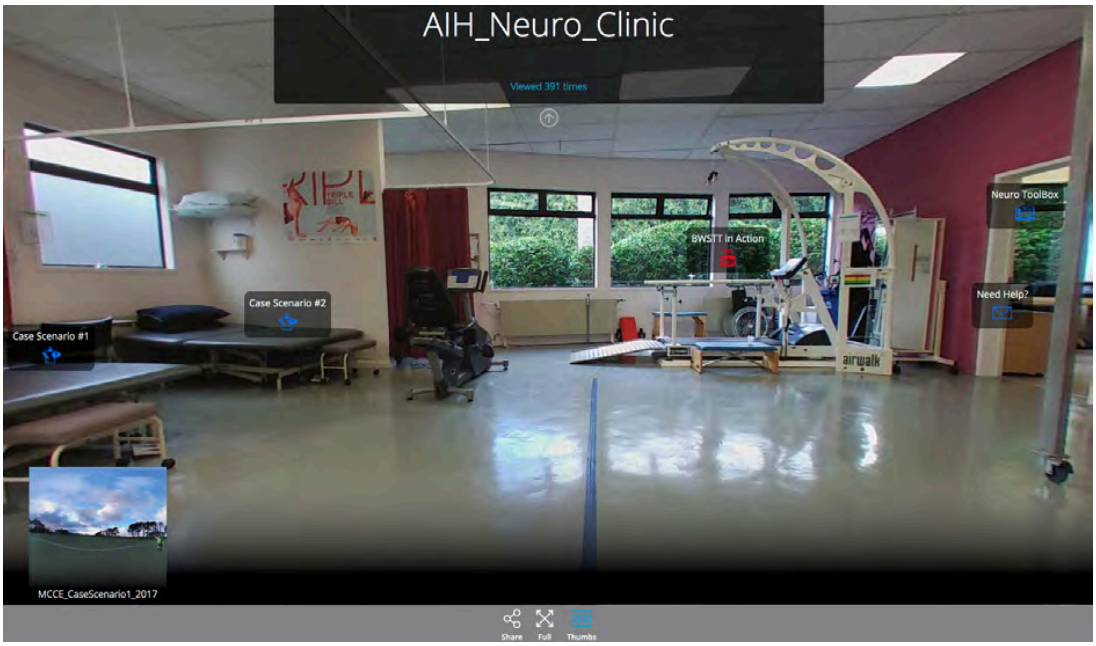

Figure 5: Physio main page of mobile VR Health Hub

The physiotherapy environment (Figure 5) depicts a typical neurological clinic. Information is provided on different types of equipment that may provide a link to a video of its use, or a question for the student to consider the clinical application of that equipment. Links to resources that they have used during their University based learning are able to be accessed within the virtual clinic (via Blackboard) and case studies typical to the clinical area are introduced (using Google Forms). Students can also access reflection forms on the use of the virtual clinic, as well as reflection on their daily experiences while on neurological physiotherapy placement.

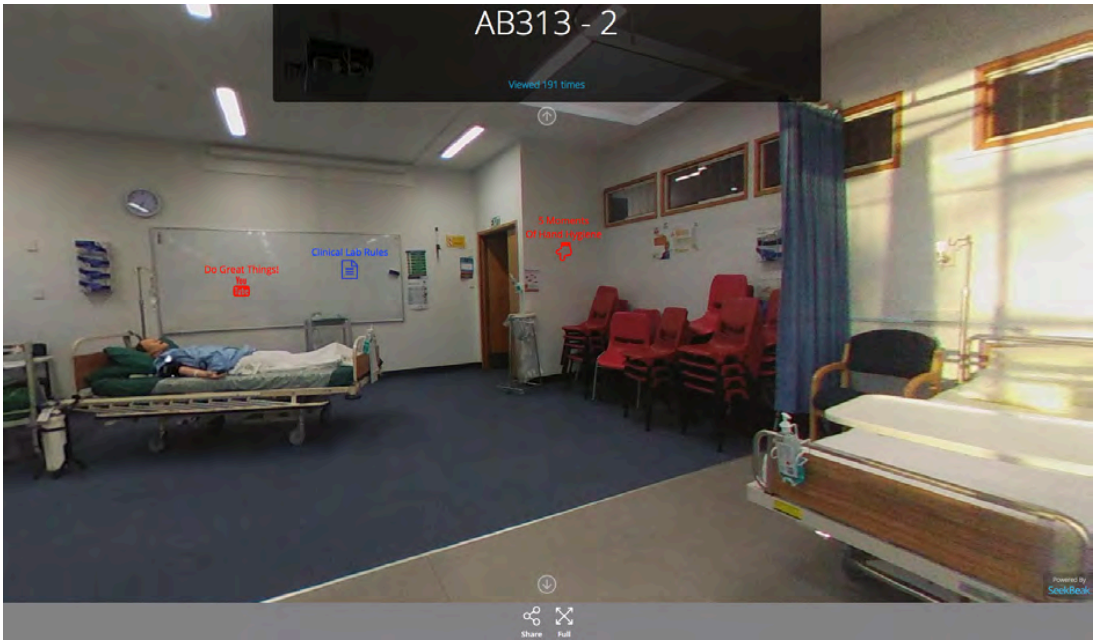

Figure 6: Nursing main page of mobile VR Health Hub

The nursing snap (Figure 6) was created to introduce new and prospective students to what they may see or experience at the university when beginning study. This includes links to information about the BHSc (Nursing) website, some of the equipment and videos of current students and graduates discussing their time at AUT. The VR room represents a ward like environment where students can learn skills prior to their practicum. For our new students, this virtual environment gives some context to what they may experience in a "Simulation Lab". Currently this snap is used in a paper where students begin their clinical paper to add context to their timetable. Students can navigate other virtual rooms that are used in blended case-based learning to allow students to notice the environment and impact this may have on their patients while collecting health information.

Discussion

In this section we discuss the key elements of the design process through implementing the identified design principles.

DP1: Basing the project within a design-based research methodology
Utilising a design-based research methodology has given the project a solid implementation structure, which has been particularly important when managing an interdisciplinary and transdisciplinary project team, and allocation of responsibilities.

DP2: Supporting the project through the establishment of a community of practice
The project represents the latest output from a community of practice of health lecturers and academic advisors established in 2015 to explore the integration of technology into authentic health education environments. The initial community of practice has expanded and grown over this time, and resulted in the establishment of trust and research informed practice as the community of practice has been recognized by the university through their establishment of a formal research cluster in 2017 to disseminate their practice, and the core team were awarded the Vice Chancellor's Award for teaching and learning.

DP3: Using heutagogy (student-determined learning) as a guiding pedagogical framework
The ethos of the project has been one of building and supporting the development capability of the end-users – the academic lecturers, in the guise of modelling student-determined learning that will hopefully filter into the future design of the curriculum.

DP4: Designing around the authentic use of mobile devices and VR
We chose an ecology of resources to support the key project goals that included the use of BYOD mobile devices and a focus upon establishing a culture of sharing and collaboration throughout the School of Health at the university. While the seven health discipline graduates will be required to work closely in interaction between various health team experts this is rarely modeled in the design of the health education curriculum. The project also serves to explore the increasing relevance of mobile devices as user-centric devices supporting health care services.

DP5: Integrate collaboration and team-work into the project activities
The interplay between the health disciplines is best illustrated in the VR Hub prototype by the interdisciplinary handover simulation (Cochrane, Stretton, et al., 2017). The lack of funding for the project has also been mitigated by the establishment of a transdisciplinary project team (Table 1) with access to various expertise and resources that have been integrated into the prototype development. The academic and technical advisors have provided support for the developers who have been the end-users (the lecturers), thus creating a development model that is not dependent upon an expensive external multimedia development team.

Future directions
The next stage of the DBR project will involve evaluating the impact of the VR health hub through gathering feedback from users – both students and department academics. The evaluation will inform the redesign of the VR Hub and the roll-out to encompass all seven health disciplines. The final stage will be exploring the potential to collaborate with other institutions who may be interested in implementing a similar methodology.

Conclusion

In this paper we have outlined the initial exploration and prototyping phases of a virtual reality health school hub Design-Based Research project. This VR environment allows students to experience core competencies and example environments for each of the seven health disciplines via a centralised single hub. Informed by a Design-Based Research methodology we have discussed the first prototype stage of the virtual health hub that

has been developed using Seekbeak. The virtual health faculty hub aims to create a model for developing inexpensive mobile BYOD immersive environments that can potentially be implemented in a variety of educational contexts. Future papers will discuss the evaluation and redesign of the project prototype and refinement of the design principles.

References

Amer, A., & Peralez, P. (2014). *Affordable altered perspectives: Making augmented and virtual reality technology accessible.* Paper presented at the Global Humanitarian Technology Conference (GHTC), 2014 IEEE.

Amiel, T., & Reeves, T. (2008). Design-Based Research and Educational Technology: Rethinking Technology and the Research Agenda. *Educational Technology & Society, 11*(4), 29-40.

Bannan, B., Cook, J., & Pachler, N. (2015). Reconceptualizing design research in the age of mobile learning. *Interactive Learning Environments, 24*(5), 1-16. doi:10.1080/10494820.2015.1018911

Birt, J., Moore, E., & Cowling, M. (2017). Improving paramedic distance education through mobile mixed reality simulation. *Australasian Journal of Educational Technology (AJET), 33*(Accepted for Special Issue on Mobile Augmented and Virtual Reality).

Blaschke, L., & Hase, S. (2015). Heutagogy, Technology, and Lifelong Learning for Professional and Part-Time Learners. In A. Dailey-Hebert & K. S. Dennis (Eds.), *Transformative Perspectives and Processes in Higher Education* (Vol. 6, pp. 75-94). Switzerland: Springer International Publishing.

Burden, K., & Kearney, M. (2016). Conceptualising Authentic Mobile Learning. In D. Churchill, J. Lu, K. F. T. Chiu, & B. Fox (Eds.), *Mobile Learning Design: Theories and Application* (pp. 27-42). Singapore: Springer Singapore.

Cochrane, T. (2014). Critical success factors for transforming pedagogy with mobile Web 2.0. *British Journal of Educational Technology, 45*(1), 65-82. doi:10.1111/j.1467-8535.2012.01384.x

Cochrane, T., Antonczak, L., & Guinibert, M. (2014, 24-26 November). *Designing Transformative Learning Environments.* Paper presented at the Rhetoric and Reality: Critical perspectives on educational technology, the 31st Ascilite Conference, Otago University, Dunedin.

Cochrane, T., Cook, S., Aiello, S., Christie, D., Sinfield, D., Steagall, M., & Aguayo, C. (2017). A DBR Framework for Designing Mobile Virtual Reality Learning Environments. *Australasian Journal of Educational Technology (AJET), 33*(6), 54-68. doi:https://doi.org/10.14742/ajet.3613

Cochrane, T., Cook, S., Aiello, S., Harrison, D., & Aguayo, C. (2016, 28-30 November). *Designing Virtual Reality Environments for Paramedic Education: MESH360.* Paper presented at the Show Me The Learning. Proceedings ASCILITE 2016 Adelaide, University of South Australia, Adelaide, Australia.

Cochrane, T., & Narayan, V. (2016). Principles of modeling COPs for pedagogical change: Lessons learnt from practice 2006 to 2014. In J. McDonald & A. Cater-Steel (Eds.), *Implementing Communities of Practice in Higher Education:*
Dreamers and Schemers (Vol. Part IV, pp. 619-643). Singapore: Springer.

Cochrane, T., & Narayan, V. (2017). Design Considerations for Mobile Learning. In C. Reigeluth, B. J. Beatty, & R. Myers (Eds.), *Instructional-Design Theories and Models* (Vol. 4, pp. 385-414). New York: Routledge.

Cochrane, T., Stretton, T., Aiello, S., Britnell, S., Cook, S., Christie, D., & Narayan, V. (2017, 4-6 December). *Developing virtual collaborative health team educational environments.* Paper presented at the Me, Us, IT! Proceedings ASCILITE2017: 34th International Conference on Innovation, Practice and Research in the Use of Educational Technologies in Tertiary Education, University of Southern Queensland, Toowoomba, Australia.

Cook, J., & Santos, P. (2016). Three Phases of Mobile Learning State of the Art and Case of Mobile Help Seeking Tool for the Health Care Sector. In D. Churchill, J. Lu, T. K. F. Chiu, & B. Fox (Eds.), *Mobile Learning Design* (pp. 315-333): Springer Singapore.

Cormier, D. (2008). Rhizomatic education: Community as curriculum. *Innovate, 4*(5), np. available http://davecormier.com/edblog/2008/2006/2003/rhizomatic-education-community-as-curriculum/.

Dolan, D., & Parets, M. (2016, January 14). Redefining the axiom of story: The VR and 360 video complex. Retrieved from http://techcrunch.com/2016/01/14/redefining-the-axiom-of-story-the-vr-and-360-video-complex/?ncid=rss

Farrell, L. (2001). Negotiating Knowledge in the Knowledge Economy: Workplace educators and the politics of codification. *Studies in Continuing Education, 23*(2), 201-214. doi:10.1080/01580370120101966

Hase, S. (2014). An introduction to self-determined learning (Heutagogy). In L. M. Blaschke, C. Kenyon, & S. Hase (Eds.), *Experiences in Self-Determined Learning* (Vol. Paperback and Kindle editions, pp. 1-9): CreateSpace Independent Publishing Platform.

Hussein, M., & Natterdal, C. (2015). *The benefits of virtual reality in education: A comparison study*. (Bachelor of Science Thesis in Software Engineering and Management Student essay), Chlamers University of Technology, University of Gothenburg, Göteborg, Sweden. Retrieved from http://hdl.handle.net/2077/39977

International Telecommunication Union. (2016). ICT facts and figures 2016*2016*(April). Retrieved from https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2016.pdf

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology, 20*(14406), 1-17. doi:10.3402/rlt.v20i0.14406

Luckin, R. (2008). The learner centric ecology of resources: A framework for using technology to scaffold learning. *Computers & Education, 50*(2), 449-462. doi:https://doi.org/10.1016/j.compedu.2007.09.018

McKenney, S., & Reeves, T. (2012). *Conducting educational design research*. London: Routledge.

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education, 70*(Supplement C), 29-40. doi:http://dx.doi.org/10.1016/j.compedu.2013.07.033

OECD. (2015). *Students, Computers and Learning*. rue André-Pascal, 75775 PARIS: PISA, OECD Publishing.

Otterness, K. (2017). Incorporating FOAM into medical student and resident education. *Clinical and Experimental Emergency Medicine, 4*(2), 119-120. doi:10.15441/ceem.16.196

Pachler, N., Bachmair, B., & Cook, J. (2010). *Mobile learning: Structures, agency, practices*. London: Springer.

Pike, T., & O'Donnell, V. (2010). The impact of clinical simulation on learner self-efficacy in pre-registration nursing education. *Nurse Educ Today, 30*(5), 405-410. doi:10.1016/j.nedt.2009.09.013

Reeves, T., Herrington, J., & Oliver, R. (2005). Design research: a socially responsible approach to instructional technology research in higher education. *Journal of Computing in Higher Education, 16*(2), 97-116.

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