Editorial: Volume 33 Special Issue on Mobile AR & VR

Integrating SOTEL in learning design

Thomas Cochrane
Auckland University of Technology

Helen Farley
University of Southern Queensland

This special issue of AJET explores the critical educational use of the recently popularised technologies of mobile augmented reality (AR) and mobile virtual reality (VR). The advent of Pokemon Go brought the world's awareness of mobile AR to a brief climax, and the hype surrounding the rise of affordable virtual reality technologies has been driven by social media giants Google and Facebook, and subsequent uptake by the main smartphone manufacturers. With the ubiquity of smartphone ownership among our students this presents a unique opportunity to explore the educational impact of these symbiotic technologies and their emergent ecosystems. While it is early days for research in these domains, we were interested in exploring beyond the technological hype to finding examples of integrating these technologies within learning designs that scaffold learner-generated content and contexts based upon a solid foundation of the scholarship of technology enhanced learning. The six articles in this special issue give us insights into these critical issues.

Introduction

The theme of this special issue of AJET explores augmenting learner-generated contexts via mobile augmented reality (AR) and mobile virtual reality (VR). AR and VR are currently two of the hottest topics in emerging technologies. The guest editors of this special issue have both been involved in the journey of mobile learning from the early days of the proof of concept of mobile learning to today's BYOD environment (Cochrane et al., 2017; Murphy & Farley, 2017) where a smartphone is considered an essential part of social connectivity and interaction. Coupled with the ubiquity of mobile device ownership, mobile AR and VR provide the potential to enhance educational technology research and practice on a level previously impractical. However, the history of educational technology adoption identifies a recurrent theme of one-step forward for technology results in two steps back in pedagogy (Herrington & Herrington, 2007), as practitioners revert to substituting safe pedagogical strategies onto new technologies. Herrington and Herrington (2007, p. 4) argue that "[a]dopting more recent theories of learning has the potential to exploit the affordances of the technologies in more valuable ways." With regard to mobile learning, Traxler (2016) asked the question "What killed the mobile learning dream?", reflecting that instead of personalised and authentic learning environments enabled by mobile technologies "We've ended up with mobile access to virtual learning environments that are being used as repositories" (2016, np). By focusing upon learner-generated contexts and the aims of the ASCILITE Mobile Learning SIG the special issue aims to provide examples of research into emancipative pedagogies beyond adding another technology fad for content delivery and teacher-directed pedagogies. The aim of the ASCILITE Mobile Learning special interest group is: To explore the intersection of mobile learning, new pedagogies, SOTEL, DBR, and authentic learning.

Mobile device ownership is wide-spread, with most students owning multiple devices, leading to many HE institutions exploring a BYOD approach to mobile learning. However, most Mlearning projects are device centric and focus upon repurposing content for delivery to small screens and substitution of pre-existing pedagogical strategies. The potential of mobile learning is to enable new collaborative connected pedagogies and professional portfolios. The Ascilite mobile learning SIG will explicitly explore the boundaries of current knowledge and approaches to mobile learning, and develop a global collaborative network of mobile learning researchers interested in exploring and implementing the frontiers of mobile learning. The SIG will specifically explore the unique affordances of mobile devices for student-generated content and experiences via such technologies as collaborative media production and sharing, VR, AR, geolocative and contextual sensors, drones and wearable technologies. (Cochrane & Narayan, 2016)

AR and VR exist on an experiential continuum spanning real world environments to experiencing immersive simulated environments. Fitzgerald et al. (2013) term this continuum from reality to VR as a mixed reality approach that ranges from interaction with real environments, to AR, through to virtual environments. Earlier research explored frameworks for designing mobile AR learning environments (Bower, Howe, McCredie, Robinson, & Grover, 2013; Cochrane, Narayan, & Antonczak, 2016; Cook, 2010; Munnerley et al., 2012; Priestnall, Brown, Sharples, & Polmear, 2009), and the development of frameworks for designing mobile VR learning environments (Amer & Peralez, 2014; Cochrane, 2016; Hsu et al., 2013; Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014), upon which this special issue builds.

Theoretical foundations

Educational technology literature is dominated by case studies of comparative analysis between existing pedagogical strategies and the same pedagogies reenacted using new technologies (Reeves, 2005; Wingkvist & Ericsson, 2011). In contrast we want to explore new learning designs and practices that were previously impossible without the integration of new technologies (Pachler, 2007; Rushby, 2012; Traxler, 2010, 2016). This involves interrogating educational problems and designing authentic situated learning environments that are student negotiated and student-determined – that is moving from teacher-directed pedagogies to student-determined learning or heutagogy (Blaschke, 2012; Hase & Kenyon, 2007; Narayan & Herrington, 2014). Several of the articles in this special issue use design based research (DBR) as a foundational methodology to inform and guide the exploration of mobile AR and VR for designing heutagogical learning environments in various educational contexts. We agree with Cook and Santos (2016) that DBR presents a research methodology that deals with the inherent *messiness* of mobile learning that is not tied to any specific geographical location and involves interaction with socio-cultural norms. DBR is often used synonymously with educational design research (EDR). Cochrane et al., (2017) applied McKenney and Reeves (2012) generic model of educational design research to the context of designing mobile AR and VR learning environments. Figure 1 outlines a generic EDR model aligned to the key supporting mobile learning theories and frameworks.
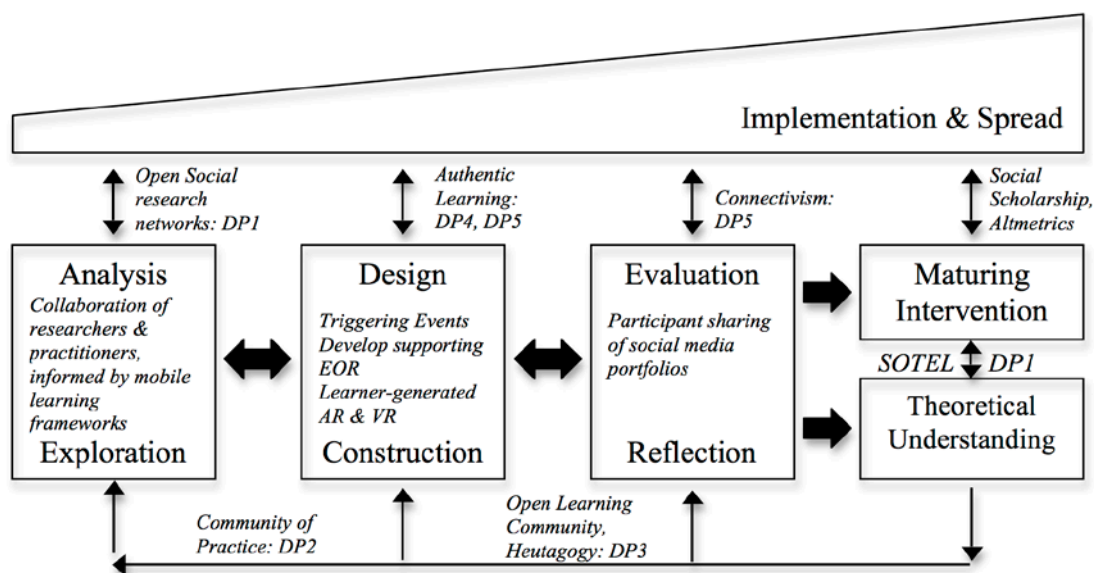

Figure 1. Generic model of EDR (McKenney & Reeves, 2012, p. 159) applied to a mobile learning framework.
Note. Design principles added to the diagram in italics.

We integrate the Scholarship of Technology Enhanced Learning (SOTEL) as a fourth DBR phase, aligned with Haynes' (2016) definition of SOTEL.

The Scholarship of Technology Enhanced Learning (SoTEL) is a new sub-branch of Boyer's

model of scholarship (scholarship of discovery, scholarship of integration, scholarship of application, and scholarship of teaching and learning) which seeks to create dialogue between the findings of educational research and actual teaching in technology-enhanced learning contexts. (p. 1)

The goal of this framework is to enable the explicit design of learning experiences around new pedagogies such as heutagogy (Hase & Kenyon, 2007), authentic and ambient learning (Herrington, Reeves, & Oliver, 2009), and connectivism (Cormier, 2008; Siemens, 2005), via learner-generated mobile AR and VR.

Mobile learning provides a catalyst for designing authentic situated learning experiences that are learner-generated, leveraging concepts from gamification, and real world augmentation and simulation. Mobile AR and VR provide opportunities for designing new ways of interacting with our physical environment and transporting users to virtual learning spaces beyond the confines of their physical location. The integration of mobile AR and VR with social media platforms provides opportunities for learners to share and collaborate in their new experiences and learner-generated content with a global audience or team (Cook & Santos, 2016). Hence this issue explores how educators can leverage the potential of mobile AR and VR.

In this issue

The articles that have been selected for this special issue traverse a wide range of disciplines from construction and maintenance, to paramedicine and anatomy. They tackle the challenges of implementing mobile VR and AR approaches, while espousing the many benefits, both realised and theorised. The hardware and software tools are varied, as are the learning aims and the place of these pilots and larger initiatives within the curriculum. Without exception, these articles emphasise the need for a planned and pedagogically sound implementation.

This special issue opens with an article that examines the potential benefits and deployment strategies for integrating location-based mobile learning games in higher education. *From Playing to Designing: Enhancing Educational Experiences with Location-based Mobile Learning Games* by Roger Edmonds and Simon Smith of the University of South Australia, leveraged the high rate of ownership of mobile phones by university students to enhance a core business course with a location-based mobile learning game (LBMLG). Gamification strategies, quizzes, and specially designed interactive activities enhanced student engagement, demonstrating the potential of this approach to deepen the thinking of students, broaden their knowledge and enhance their understanding of their local environment. Using the knowledge gleaned from this pilot, the authors extended the approach to a range of disciplines with similarly positive results. Evolving the strategy, students were recruited as designers and developers of LBMLGs which they shared with their peers. The benefits already mentioned were augmented even further as students acquired contemporary digital skills, enhancing their ability to navigate an increasingly digital world. The article concludes by outlining the strategies for developing and deploying the games and ensuring good student engagement.

Simulation has long been used as a way of supplementing clinical practice opportunities in a number of health-related and other practically oriented professional disciplines. A well-known example would be the use of flight simulators for aircraft pilots. The second article in our special issue highlights a novel form of simulation using mobile mixed reality in paramedic education delivered at a distance. *Improving paramedic distance education through mobile mixed reality simulation* by James Birt from Bond University, and Emma Moore and Michael Cowling, both from Central Queensland University, describes the design and delivery of a simulation that aids emerging paramedics develop critical airway management skills. What makes this article especially significant is that it outlines a mechanism by which practical skills can be acquired *at a distance* and not just in a face-to-face residential school or in a clinical situation. Results indicate that students who made use of the mixed reality simulation performed better using airway mannequins than those who did not, heralding great promise for the use of this approach more broadly.

Though the use of mobile mixed reality, virtual reality and augmented reality technologies promises educators a greater array of tools for effective learning and teaching in higher education, the authors of our third paper in this special issue remind us that good experiences must be deliberately and carefully designed. Thomas Cochrane, Stuart Cook, Stephen Aiello, Duncan Christie, David Sinfield, Marcus Steagall, and Claudio Aguayo all from the Auckland University of Technology, in their paper, *A DBR framework for*

designing mobile virtual reality learning environments, outline an approach to developing more authentic mobile VR experiences for students. To illustrate the efficacy of their approach, two cases studies from paramedicine (Multiple Environment Simulation Hub) and visual design (Augmented Classroom project) are examined in detail. The authors convincingly argue that genuine curriculum redesign requires more than the simple substitution of new technologies into old pedagogical strategies. They go on to reveal a strategy for the effective integration of mobile virtual reality into the curriculum that takes account of the particular pedagogical affordances of those technologies.

Communication is integral to any workplace learning but particularly so when working collaboratively. *Mobile augmented communication for remote collaboration in a physical work context* authored by Jana Pejoska-Laajola, Sanna Reponen, Marjo Virnes, and Teemu Leinonen of Aalto University, Finland, examines how informal learning can be facilitated when video calling can be supplemented by the use of a drawing tool to create an augmented reality experience for the user. This in turn strengthens the acquisition of context-sensitive knowledge through virtual interactions, reinforcing contextual information about objects, events and significant places. The users featured in this paper used head-mounted displays (HMD) to show other interested parties who may be geographically remote what they are seeing. Using an app, SoAR (Social Augmented Reality App), they can add notes to the video stream or point to a particular object or part thereof, which then gets transmitted to other people enabled in the interaction. In this way discussions can take place with input to the onsite user from those who are remotely located. Though this pilot was conducted in the construction and maintenance industries, it is not difficult to envisage how this approach could be used across a wide range of work, field-work and clinical contexts.

With a great number of affordable virtual reality set-ups newly available on the market, it can be difficult for educators to determine, before they purchase equipment, what will best suit their needs. The penultimate article in our special issue, *Virtualisation devices for student learning: Comparison between desktop-based (Oculus Rift) and mobile-based (Gear VR) virtual reality in medical and health science education*, by Christian Moro, Zane Štromberga, and Allan Stirling of Bond University, teases out some of the factors which distinguish mobile VR (using GearVR) from desktop VR (using the Oculus Rift headset). The authors delivered an anatomy lesson on the spine using both set-ups to health sciences students. Both appeared to be useful to students to deliver a supplementary learning opportunity to lectures. What did distinguish the mobile VR set-up was that it induced some slight physical symptoms in users, and the authors suggest shorter VR sessions to counter this. They also suggested that given that both the mobile and desktop set-ups elicited similar student results, educators may prefer the cheaper mobile set-up.

Key themes in mobile learning: Prospects for learner-generated learning through AR and VR written by Claudio Aguayo, Thomas Cochrane, and Vickel Narayan of Auckland University of Technology, creates a fitting conclusion to our special issue on Mobile AR and VR. The paper reports on an extensive literature review conducted as part of a six-institution collaborative project. Key themes were identified that related specifically to user-generated content within this domain and were grouped under five broad areas: (1) philosophical and theoretical frameworks; (2) mobile learning research (theory and findings); (3) pedagogies and learning methodologies; (4) mobile learning affordances; and (5) key issues in mobile learning. The authors concluded that though the field of mobile learning research has progressed and matured, the uptake by universities is still low. They argue that the way to ensure the effective use of emerging mobile technologies such as AR and VR is to leverage design based research to ground mobile learning research and application in a rigorous scholarship of technology enhanced learning.

In summarising the contribution of this special issue on mobile AR and VR we hope that this special issue will enable AJET to take a leading role in mobile AR and VR research through the publication of a selection of the first empirical series of studies on mobile AR and VR, as well as a keystone review of the state of the art of mobile AR and VR in higher education.

Acknowledgements

References

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

Blaschke, L. M. (2012). Heutagogy and lifelong learning: A review of heutagogical practice and self-determined learning. *The International Review of Research in Open and Distance Learning, 13*(1), 56-71.

Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D. (2013, October). *Augmented reality in Education; Cases, places, and potentials.* Paper presented at the 2013 IEEE 63rd Annual Conference International Council for Educational Media (ICEM), Singapore.

Cochrane, T. (2016). Mobile VR in education: From the fringe to the mainstream. *International Journal of Mobile and Blended Learning, 8*(4), 45-61. https://doi.org/10.4018/IJMBL.2016100104

Cochrane, T., Antonczak, L., Guinibert, M., Mulrennan, D., Rive, V., & Withell, A. (2017). A framework for designing transformative mobile learning. In A. Murphy, H. Farley, L. Dyson, & H. Jones (Eds.), *Mobile learning in higher education in the Asia-Pacific Region: Harnessing trends and challenging orthodoxies* (Vol. 40, pp. 25-43). Sinapore: Springer International.

Cochrane, T., & Narayan, V. (2016). About the Ascilite Mobile Learning Special Interest Group (#asciliteMLSIG). Retrieved from https://ascilitemlsig.wordpress.com/about/

Cochrane, T., Narayan, V., & Antonczak, L. (2016). A framework for designing collaborative learning environments using mobile AR. *Journal of Interactive Learning Research, 27*(4), 293-316.

Cook, J. (2010). Mobile phones as mediating tools within augmented contexts for development. *International Journal of Mobile and Blended Learning, 2*(3), 1-12.

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). Singapore: Springer International.

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

FitzGerald, E., Ferguson, R., Adams, A., Gaved, M., Mor, Y., & Thomas, R. (2013). Augmented reality and mobile learning: the state of the art. *International Journal of Mobile and Blended Learning, 5*(4), 43-58. https://doi.org/10.4018/ijmbl.2013100103

Hase, S., & Kenyon, C. (2007). Heutagogy: A child of complexity theory. *Complicity: An International Journal of Complexity and Education, 4*(1), 111-118.

Haynes, D. (2016). Introducing SOTEL. *International Journal for the Scholarship of Technology Enhanced Learning, 1*(1), 1-2.

Herrington, A., & Herrington, J. (2007, November). *Authentic mobile learning in higher education*. Paper presented at the AARE 2007 International Educational Research Conference, Fremantle. http://researchrepository.murdoch.edu.au/5413/

Herrington, J., Reeves, T., & Oliver, R. (2009). *A guide to authentic e-learning*. London: Routledge.

Hsu, E. B., Li, Y., Bayram, J. D., Levinson, D., Yang, S., & Monahan, C. (2013). State of virtual reality based disaster preparedness and response training. *PLOS Currents Disasters, Apr 24*(1), https://doi.org/10.1371/currents.dis.1ea2b2e71237d5337fa53982a38b2aff

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. https://doi.org/10.1016/j.compedu.2013.07.033

Munnerley, D., Bacon, M., Wilson, A., Steele, J., Hedberg, J., & Fitzgerald, R. (2012). Confronting an augmented reality. *Research in Learning Technology, 20*, 39-48. https://doi.org/10.3402/rlt.v20i0.19189

Murphy, A., & Farley, H. (2017). Introduction: Supporting the sustainable implementation of mobile learning for higher education in the Asia-Pacific Region. In A. Murphy, H. Farley, L. E. Dyson, & H. Jones (Eds.), *MobilelLearning in higher education in the Asia-Pacific Region: Harnessing trends and challenging orthodoxies* (pp. 3-23). Singapore: Springer International.

Narayan, V., & Herrington, J. (2014, November). *Towards a theoretical mobile heutagogy framework.* Paper presented at the Rhetoric and Reality: Critical perspectives on educational technology, 31st Ascilite Conference, Otago University, Dunedin.

Pachler, N. (Ed.) (2007). *Mobile Learning: Towards a research agenda* (Vol. 1). London: WLE Centre, Institute of Education.

Priestnall, G., Brown, E., Sharples, M., & Polmear, G. (2009). A student-led comparison of techniques for augmenting the field experience. In D. Metcalf, A. Hamilton, & C. Graffeo (Eds.), *Proceedings of mLearn2009: 8th World Conference on Mobile and Contextual Learning* (pp. 195-198). Florida, CA: University of Central Florida.

Reeves, T. (2005). No significant differences revisited: A historical perspective on the research informing contemporary online learning. In G. Kearsley (Ed.), *Online learning: Personal reflections on the transformation of education* (pp. 299-308). Englewood Cliffs, NJ: Educational Technology Publications.

Rushby, N. (2012). Editorial: An agenda for mobile learning. *British Journal of Educational Technology, 43*(3), 355-356. https://doi.org10.1111/j.1467-8535.2012.01313.x

Siemens, G. (2005). Connectivism: Learning as network-creation. Retrieved from http://www.elearnspace.org/Articles/networks.htm

Traxler, J. (2010). Will student devices deliver innovation, inclusion, and transformation? *Journal of the Research Center for Educational Technology, 6*(1), 3-15.

Traxler, J. (2016). What killed the mobile learning dream? Retrieved from https://www.jisc.ac.uk/inform-feature/what-killed-the-mobile-learning-dream-26-feb-2016?

Wingkvist, A., & Ericsson, M. (2011). A survey of research method and purposes in mobile learning. *International Journal of Mobile and Blended Learning, 3*(1), 1-17. https://doi.org10.4018/jmbl.2011010101

Corresponding author: Thomas Cochrane, thomas.cochrane@aut.ac.nz