Interdisciplinary Journal of Virtual Learning in Medical Sciences

Original Article

Successful Integration of Virtual Worlds in Learning Environments: A Case Study of a Supportive Learning Ecosystem

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ABSTRACT

Background: Using virtual worlds with students and faculty in Initial Teacher Education (ITE) can provide exciting opportunities to develop innovative pedagogies. This work can begin in the ITE courses and filter into K-12 classrooms. Identifying the best practices is of the utmost importance in facilitating effective teaching and learning. The present case study seeks to highlight the elements that influence the successful integration of virtual worlds in learning environments.

Methods: This case study was part of a more extensive participatory action research project (PAR). In that four-year project (2010-2014), data were gathered from over 1500 ITE students and six faculty at a regional university in Australia. The inductive analysis of the data gave rise to several case studies, one of which is presented in this paper. The data sets were obtained from virtual world interventions, surveys and interviews.

Results: It was found that virtual worlds can support teachers in developing innovative pedagogical approaches in classrooms. However, resistance from one or more elements in the learning ecosystem can hamper the integration of virtual worlds into the educational landscape. These elements range from learners to technology systems. The inductive analysis identified the variables that influence the adoption of virtual worlds and facilitate innovative pedagogies.

Conclusion: This paper delineates various elements of a learning ecosystem and their importance in the adoption of a sustainable virtual world, regardless of the learning application used. A specific case study is discussed here, since it best demonstrates the value of a supportive learning ecosystem and the practical ways of utilizing its elements to support future integration of virtual worlds. Suggestions are also made for future implementations in any faculty across a university.

Keywords: Virtual worlds, Learning ecosystems, Initial teacher education, Teacher, Education

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Please cite this paper as:
Jacka L. Successful Integration of Virtual Worlds in Learning Environments: A Case Study of a Supportive Learning Ecosystem. Interdiscip J Virtual Learn Med Sci. 2021;12(3):169-176.doi:10.30476/IJVLMS.2021.90912.1091.

Received: 22-04-2021
Revised: 22-07-2021
Accepted: 25-07-2021

Introduction

The efforts to integrate virtual worlds in support of teaching and learning in higher education have been inconsistent at best. Virtual world platforms like *Second Life* are generally embraced thanks to the affordances that they can offer to educators and students (1, 2). However, over a decade

after the first introduction of *Second Life,* a number of significant barriers have yet to be overcome. These have been identified as issues arising from technology, institutions, students, and individuals/faculties (3-6). Each of these barriers are attributed to some specific elements of the learning ecosystem. These elements should function properly to maintain virtual worlds as an effective part of the teaching and learning environment.

A learning ecosystem encompasses a complex interplay of all its living and non-living elements within their own contexts. Educators and researchers have drawn on an analogy with nature, and adapted scientific methods to the teaching-learning context and specifically to digital and online learning (7-11). Brown (12) first suggested that the Internet provided the opportunity to have a learning ecology that would encompass various communities linked together and each influencing the other. The analogy is useful when applied in the integration of emerging technologies; it helps with coordinating the elements of an ecosystem, and identifying the necessary changes due to the interaction of these elements within their context.

In a study entitled "Virtual worlds in pre-service teacher education: The introduction of virtual worlds in pre-service teacher education to foster innovative teaching-learning processes" (1), over 1500 students and six staff in a regional Australian university were introduced to virtual worlds for pre-service and K-12 teaching. Several elements of the learning ecosystem were found to be fundamental to the successful integration of virtual worlds in the participants' current and future teaching practices. In this paper, a single case from that larger study is presented as an example of the manner in which an ecosystem can influence and support the effective integration of virtual worlds for positive learning outcomes. A number of recommendations are made to highlight the role of higher education learning ecosystems in facilitating the widespread integration of virtual worlds. Providing educators with a framework of recommendations is one step towards better uptake and integration of virtual worlds.

Methods

Study Design

This case study applied an Action Research (AR) meta-methodology, which includes the researcher as an active participant and seeks to change the learning ecosystem through this approach. As a meta-methodology, AR determines a researcher's philosophical position while PAR provides the process or method in which the researcher is engaged.

The 3D virtual worlds in this study are commonly known as desktop virtual worlds, under the broad umbrella term of *OpenSim* environments. The technology used here is best described in Gregory et al.'s definition of a virtual world: "a computer-based, immersive, 3D multi-user environment that simulates real (or imaginary) life, experienced through a graphical representation of the user" (13). Given their relatively untapped potential as a research setting, desktop virtual worlds were selected as a research site where innovative pedagogies could be explored. This means that they would be a novel learning environment for ITE students and faculty. The participants' perceptions were anticipated to be one of preparedness to explore new territories in the learning ecosystem. However, the present case study can only be regarded as part of a larger study. It sheds light on the experiences of the participants to illustrate the impact of the ecosystem of a learning environment and how it can be manipulated to provide optimal conditions for the use of virtual worlds.

Jacka (1) presents the results of the more extensive study mentioned above. The participants went through different phases of an engagement model including pre-realisation, realisation, replication, reimagining, and implementation. The case study in this paper was performed in the reimagining and implementation phases. The participants were unique in their capacity to shift their pedagogical approach and implemented an emerging and sometimes challenging technology with positive results.

Setting and Participants

Over a four-year period (2011-2015), research was undertaken to observe, document and reflect on the effects of implementing virtual worlds in the learning ecosystem of an ITE course at an Australian regional university. Over 1500 students and six faculty were involved. These numbers represented close to 25 percent of all enrolments in the courses offered by the University's School of Education, and 20 percent of the teaching faculty. While 1500 students were introduced to virtual worlds, a third of them (approximately 500) participated in contributing to the data. They were given opportunities to respond via blog posts, portfolio reflections, and more traditional data collection tools, including surveys and interviews. Overall, the data collection sites and intersections in the ecosystem were varied, providing a comprehensive view of the expectations, beliefs and experiences of staff and students regarding the integration of virtual worlds in teaching and learning.

Content analysis was undertaken to look for the most significant concepts across the interviews, surveys and student reflections. The inductive analysis gave rise to some patterns, themes and categories. The inductive analytical process assists a PAR researcher to approach the data without preconceived notions of what the data will reveal. This type of open-coding is, as described by Corbin and Strauss (14), intended to "help the analyst gain new insights into the data by breaking through standard ways of thinking about (interpreting) phenomena reflected in the data" (p. 423). After the inductive analysis on the initial data set, each category was utilised in a more deductive process representing the second stage of data analysis. What emerged was an analyst-constructed typology. Data was analyzed using a combination of NVivo software and XCEL spreadsheets throughout each of the PAR cycles.

Results

The case study presented in this paper is drawn from a broader study whose results can be found in Jacka (1). The study exemplifies the factors that influenced an ITE student in her approach to virtual worlds. The significant point about this participant was her perseverance in the use of virtual worlds through the entire four-year program and her use of virtual worlds as a teacher of K-12 students.

It was found that, over the four-year period, the barriers could be addressed and mitigated through the changes made at various levels in the ecosystem. In the original study, the participants realized that their motivation to use the new technology determined their perseverance in overcoming the barriers. The conditions needed to be in place, including the support from the institution where the course was held, i.e. the University. At the beginning of the research, the University had a dedicated *Second Life* island which was fully funded and maintained. During the four years, the island was decommissioned, and the faculty were actively discouraged from using *Second Life*.

Case Study Example - A Supportive Learning Ecosystem

One of the students involved in this research provided an example of what can be achieved when most elements in the learning ecosystem are working towards the same goal. She had already worked as an Early Childhood Education Teacher's Aide, and had substantial experiences as a teacher. She was a relatively typical mature-aged student with previous experience of using computers for simple tasks such as email and Internet surfing. She chose to undertake the technology course followed by another course that involved the virtual worlds in order to upskill herself. She was hoping to gain an advantage in the competitive teaching market. Despite her lack of experience with technology, she was highly motivated and displayed a growth mindset. During the four years, she completed 18 virtual world projects suitable for use in a primary school setting.

The participant's choice of courses and her attitude in engaging with virtual worlds

technology could help with identifying the best practices and most effective support from the learning ecosystem. Her first experience was with a group of three where she was the resource finder, and the other two were young men who identified themselves as 'gamers' with significant technology skills. Her capacity to work with these two peers helped her build confidence and develop a well-designed and executed resource for science education. This led her to volunteer to utilize virtual worlds in other courses despite her peers' unwillingness to join in. Being the only volunteer, she was provided with one-on-one support from the researcher who was interested in exploring what might be required for success in this endeavor. She gained personalized learning experiences as she received technical support to develop her ideas. The result was another successful build demonstrating how primary school children could use the virtual world to gather data and generate a deeper understanding of mathematical concepts (Figure 1).

After a year of using virtual worlds, she decided to implement the technology in a primary school where she was doing practicum. She initially received technical assistance in developing effective pedagogy from the researcher, who was also the tutor at the school and became her mentor. She also received support from the other parts of the learning ecosystem, most specifically in the school. The principal and the supervising teacher provided continued support and engagement in the process. She commented that the principal's support was critical in working with the virtual worlds and dealing with technical requirements and uncertainties of other teachers. After two weeks of working with schoolchildren, the researcher visited the student to offer hands-on support. The student identified this particular instance as the moment when the students, the principal and the teacher acknowledged that the virtual worlds provided valuable learning outcomes. Her response to this development was:

> The African refugee kids were helping, and then we did running races around the athletics track. Seeing their excitement was fantastic, and then I went and got the principal. He was just blown away, and we were all very excited. The kids were so happy. It was actually real. We actually got it to work. If *Sim-on-a-Stick* hadn't started then none of this would have happened. That was the catalyst (Participant's reflection, 1).

Her statement highlights the various elements that worked together to help her pursue the use of virtual worlds in this learning ecosystem. The children were an integral part of the system as they had been disengaged from regular classrooms until that point. With the integration of virtual worlds, they were fully engaged in the learning environment and established their expertise among peers. The learning outcomes were in line with the experiences she had designed based on the curriculum, another vital part of the learning ecosystem. This particular finding is further explored in Jacka's study (15).

The participant in this study used blogging to document and share her experiences with the educators worldwide, who were also

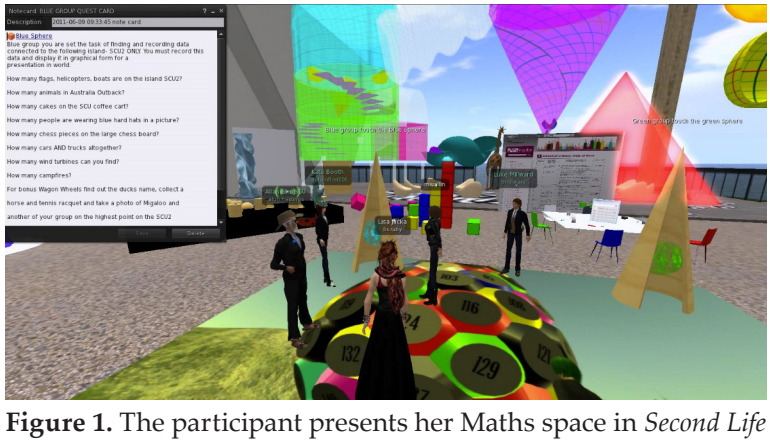

Figure 1. The participant presents her Maths space in *Second Life*

Table 1. Components of a learning ecosystem working together to integrate virtual worlds in teaching and learning (adapted from the work of the author (1))

Elements of the Learning Ecosystem	Recommended measures for sustainable integration across a university
Management	• Mandating the use of virtual worlds across the university • Acknowledging innovative efforts to use virtual worlds through the inclusion of case studies in reports, newsletters, media releases and awards • Generating positive discourse through personal conversations, directives and acknowledgements • Financing the development of virtual world environments across different disciplines
Technology Services	• Configuring all computers on campus (fixed and portable) to meet the specifications required for a variety of virtual worlds • Setting up an *OpenSim* environment hosted by the university • Ensuring that faculty have access to laptops capable of running the virtual worlds viewers away from campus • Configuring all ports to allow faculty and students gain access using their university or personal computers • Updating all computers when required by the virtual worlds' viewers • Taking a leadership role and providing advice on current trends in virtual worlds • Providing expert help to troubleshoot technical, software and hardware problems
Head/Dean of School	• Providing professional development opportunities for faculty members who are interested in virtual worlds, and allocating time for them to develop proficiency and resources • Promoting the activities of the faculties that use virtual worlds • Generating a positive discourse about the use of virtual worlds • Funding the development of a virtual world environment that can be utilised by all faculties and students in various disciplines • Supporting and promoting research on the use of virtual worlds in different academic disciplines, and more widely across different departments of universities • Taking a leadership role in the use of virtual worlds and in transition to this new technology
Faculty	• Designing complex virtual worlds learning experiences as part of design teams • Joining collaborative networks to discuss, critique and design virtual worlds learning experiences • Mentoring other faculty and students • Conducting research and presenting works in conferences, books and journals • Encouraging students to develop their expertise
Students	• Developing skills in virtual worlds beyond any basic expectations driven by assessment • Joining professional networks of users who deploy virtual worlds in their practices • Designing virtual world environments • Implementing virtual worlds in academic settings • Mentoring other students in the use of virtual worlds

interested in using virtual worlds in their schools. Her efforts reflected the value of virtual worlds in primary education, and placed her as a leader in using educational technology in primary schools. When interviewed about her experience, she stated that she "had a lot of satisfaction out of building that very first project and now I'm asked to present at conferences and workshops to show other teachers and that's all because I answered that first email". Upon obtaining full-time ongoing employment as a primary school teacher, she stressed that a significant contributor to her success was the skills she developed using virtual worlds. That would not have been possible without all parts of the

learning ecosystem working together.

The data analysis resulted in a table of recommendations (Table 1) which outlines the requirements for the university management, technology services, school principals, faculty and students to introduce, support, and develop virtual worlds at a full scale in an educational institution. Each of these elements of the learning ecosystem has a significant role to play to ensure that emerging technologies—in this case, the virtual worlds—secure significant learning outcomes for the students.

Discussion

The successful experiment reported in this study illustrates the elements of the learning ecosystem that must be working properly to achieve a common goal. The activities of the participant in question were framed in a broad context that included higher education, primary education, her learning environment, and the broader community of virtual world educators. The study in which she was the only participant took place in the higher education context. The analysis of data revealed the elements of the learning ecosystem that needed to support virtual worlds for a sustainable integration to occur.

The infrastructure and management in a higher education institution can be vital in promoting and supporting new approaches in teaching and learning, including the integration of an emerging technology. Laurillard (16) notes that "The institutional context must afford and encourage the actions" that the faculties need to undertake, so that they can achieve what they envisage. This means that technology (hardware or software) and technological support are critical in determining faculties' or students' willingness to pursue what might be a hard path with unknown yet exciting technological innovations. O'Reilly et al. (17) argued that there is a correlation between a) the level of support provided by the technology services (infrastructure) and b) faculty development for the successful implementation of virtual worlds and effective learning. Despite these observations, the emerging technologies that are not officially deployed by an institution often go unsupported until the staff can make a breakthrough in demonstrating the value of their integration. While the literature points to the importance of coordination between the variables in a learning ecosystem, little research has been done on the immersive virtual world environment in education. Galarneau (18) provides some insights on critical factors in applying a "learning ecosystem" structure to online gaming virtual worlds. She suggests that the concept of a learning ecosystem helps provide a framework attuned to the realities of learning in the 21st century. Kadel et al. (19) explored scalable advanced learning ecosystems (SALEs) to assess the value that a virtual world might bring to new learning experiences. In their work they identified broad themes to support SALE. Their study covered variables similar to the ones in the present research, including learners, learning environment, policies, technological infrastructure, and business sense.

To maintain virtual worlds as a sustainable technology that is fully utilised and embedded into the learning ecosystem, the support from technology services staff is paramount. Without this support, faculties rely on their individual ability to address problems and access the necessary resources. Choices made in relation to the purchase of equipment or rental of Sims and the level of network capability, all present challenges that can be overcome through the commitment of the university management to support emerging technologies and innovative pedagogy. Hardware provided to university students and faculty are primarily designed to facilitate simple tasks such as word processing and internet surfing. However, these low-end equipment and their poor graphics impact the experience of the virtual world in a manner that is likely to deter them from future use. They may question why they should go virtual when the physical world is far better, or why they have to struggle with technical problems when turning up to a physical class provides better audio and visuals. When a university commits itself to addressing the needs for best practices in virtual learning, one of the

key components of the learning ecosystem is working to support the other elements.

The limitations to this case study are evident in the fact that only one participant was involved. The data from the larger study provided the themes that influenced the performance of all participants. When presented as parts of a learning ecosystem, these themes provide a framework by which the learning designer and/or faculty can mitigate the barriers within the system (see table 1). While the use of only one participant in this discussion may be seen as a limitation, the benefits are the capacity to highlight exactly what components needed to function properly for future implementations.

As with any ecosystem, a learning ecosystem is made up of a variety of intersecting elements; each has the potential to affect and change the other and create a new ecosystem. As a metaphor for a learning environment, the ecosystem can be vast and encompass all the many variables that make up an individual's learning experience. It might be a rather minor constituent of a larger macrosystem. Identifying the elements that need to work together to create new element(s) could help facilitate the integration of emerging technologies and new pedagogical approaches that change and challenge the existing ecosystem(s).

This paper presented one dimension of a larger study seeking to explore the integration of virtual worlds into a learning ecosystem. The complexity of this undertaking revealed that a number of elements in the learning ecosystem ought to be fully prepared for a sustainable integration and, more importantly, a demonstrable impact on student learning. Future research would find it useful to take note of the elements discussed in this study, and to determine if they work in coordination to achieve the desired objectives in technology integration projects. Most importantly, we move quickly towards recognizing this need to fully harness the immersive technologies available to teachers and learners when traditional in-person approaches prove to be increasingly problematic.

Ethical Considerations

This study was approved by the Ethics Committee of Southern Cross University, NSW, Australia.

Availability of Data and Materials

The data that support the findings of this study are available from the corresponding author on request.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgements

None.

Funding/Support

No outside funding or support was provided for this work.

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