RESISTANCE TO ADVOCACY: PRE-SERVICE TEACHERS RECOGNISING THE POTENTIAL OF CURRICULUM-BASED VIRTUAL WORLDS FOR TPACK-FRAMED SCIENCE TEACHING

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Abstract

It’s time to prepare teachers to take the plunge to teach in virtual worlds. Students are already there and their teachers need to follow. Unfortunately, teachers are often resistant to change their teaching practice, especially regarding the use of Information and Communication Technology (ICT) such as virtual worlds. The authors report on the experience of a cohort of pre-service teachers who transitioned from resistance to advocacy as a consequence of immersion in a curriculum-based virtual world. Curriculum-based interactive multi-user virtual worlds contribute to learning through transformational play combining learning, playing and helping. Learners make informed decisions whilst immersed in play. A recommended virtual world is Quest Atlantis; research-based and designed for learners aged nine to sixteen. Importantly, teachers need to be convinced that teaching objectives can be met in virtual worlds. Use of the Technological Pedagogical Content Knowledges (TPACK) framework can provide such evidence. Most Significant Change Stories gathered from pre-service teachers show the pre-service teachers transforming from resistance to advocacy. Findings indicated that once the pre-service teachers experienced transformational play they realised the value of the use of virtual worlds in teaching and that play can support learning and meet teaching objectives.

Introduction

Information Communication and Technologies (ICT) are now ubiquitous, not only in everyday life but also in education. However, ICT use is not without discussion from learners, parents, teachers and teacher educators as to its effectiveness and the resulting issues around implementation and professional development. To achieve excellence in schools, teachers must be able to integrate ICT into the curriculum and the groundwork must be done at the pre-service teacher level (Fisher, 2000). There has been considerable research into the resistance of teachers to ICT (Johnson, Adams, & Haywood, 2011; Papert, 2001; Rice, 2007). Papert (2001) described resistance as preventing the good things that should happen in schools from happening. ICTs, in particular curriculum-based virtual worlds, offer the potential to develop global perspectives, intercultural collaboration and the capacity to find complex approaches to complex problems (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005). The importance of the pre-service teachers learning to use a curriculum-based virtual world cannot be overestimated. Teachers are potentially change agents in schools who play a critical role in the successful implementation of technology; a positive attitude to computers and using technology in the curriculum is linked to successful learner outcomes from using ICT (Teo, 2008). Once pre-service teachers move along an attitude continuum from resistance towards advocacy, the potential for their students to develop their own ICT competencies improves.

This paper presents the story of four pre-service teachers as they move from resistance to advocacy when studying a secondary science methods unit, where a curriculum-based virtual world was integrated as a mandatory component of the unit, incorporated into the outcomes, content, learning activities, and assessment. This integration was framed around Mishra and Koehler’s (2006) Technological Pedagogical Content Knowledge (TPACK) model for teacher education. Before reporting relevant aspects of the story, research into curriculum-based virtual worlds is described and TPACK is elaborated.
Curriculum-based Virtual Worlds

Virtual worlds are defined by Bell (2008) as:

A synchronous, persistent network of people, represented as avatars, facilitated by networked computers.

Distinguishing a virtual world from an online game, Bateman (2007) explained that the avatar must be critical to the play and real world spatial activities such as navigation must occur. Therefore a curriculum-based virtual world could be defined as using the set of subjects of a prescribed course of study (Oxford Dictionaries Online Project Team, 2012) of the relevant education system to define the activities within its space. Virtual worlds incorporate the critical attributes of social constructivist learning environments (Bronack et al., 2008) by allowing learners to experience a combination of context, content and activities. There are many examples of the use of virtual worlds in education, 
Second Life, World of Warcraft, The River City Project, AET Zone and Open Sim. While these worlds can be used for curriculum-based activities, the worlds themselves are not curriculum-based.

Curriculum-based virtual worlds have been used in education for over two decades. Winn and Bricken (1992) experimented with developing virtual worlds in the early nineteen nineties to assist them with teaching mathematics. Their theory and that of others, was that early adopters of technologies in the classroom were trying to replicate “the teacher” or were taking a didactic approach. Winn and Bricken believed that learners learn best by constructing learning for themselves. Therefore, the requirement was for a virtual world where learners could construct their own learning.

An example of a curriculum-based virtual world is Quest Atlantis (QA), an interactive 3D virtual world, developed initially by The University of Indiana and released in Beta in January 2003 (Barab et al., 2005). QA is designed for 9 to 16 year old learners and its cornerstone is the philosophy of combining play with learning with social conscience, that is, the theory of transformational play. QA has been built on, and regularly revised in the light of, sound research. Teachers can provide an ongoing cycle of feedback to learners as they progress through the activities. Sometimes learners cannot progress unless they have read and/or acted upon feedback provided. Teachers can restrict progression and add an extra activity, such as a class discussion or a “real” activity that complements the current activity. Assessment tasks can be embedded within QA either directly by the teacher or implicitly through the quests, missions or units.

The advantage of curriculum-based virtual worlds is that they allow educators to go beyond textbooks and worksheets and use an alternative pedagogy, where “narratively rich, personally motivating, conceptually rich and situationally consequential” technologies provide support for educators to “support their students engagement with the content” to develop skills beyond mastering the technology tools (Gresalfi & Barab, 2011, p. 308). Learners become engaged with the content procedurally, conceptually, consequentially, and critically and therefore learning is more likely to occur than in traditional learning environments.

The widespread use of virtual worlds in education is around the corner, according to the New Media Consortium (NMC) 2012 Higher Education Horizon Report (Johnson, Adams, & Cummins, 2012). Game-Based Learning will be a feature of the Higher Education study experience within a two to three year time frame. It is reasonable to assume that this will then filter into pre-service teacher education and therefore into school education. Research into the use of these curriculum-based virtual worlds in Australian education at any level is lacking and a motivation for the research reported in this paper. With the importance of ICT now being placed in pre-service teacher education, a useful framework to describe the necessary knowledges about ICT for education is TPACK.

TPACK Framework

TPACK is a framework devised by Mishra and Koehler (2006, p. 1017) to “capture some of the essential qualities of teacher knowledge required for technology integration in teaching”. This
framework was developed from Shulman’s (1986) work on “pedagogical content knowledge”. The TPACK framework (Figure 1) links classroom practice to theory through: what to teach (content knowledge); how to teach (pedagogical knowledge); and how to use technologies (technological knowledge). Mishra and Koehler developed this framework to add technology to the original “pedagogical content knowledge” model whilst working in the area of teacher professional development. For the purpose of this paper only Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge (TPACK) will be addressed because Pedagogical Knowledge (PK) and Content Knowledge (CK) do not involve the use of ICT and are therefore outside the scope of this research.

![Figure 1: Technological Pedagogical and Content Knowledge Framework (P. Mishra & M. Koehler, 2006)](image)

Research Focus

It’s time to research the attitudes of pre-service teachers to the potential and relevance of curriculum-based virtual worlds as a learning environment. This is especially relevant because ICT has been placed as a cross-curricular priority of the new Australian Curriculum (Toner, 2012) proposed for release in draft form to Australian Secondary schools in July 2012 (Australian Curriculum Assessment and Reporting Authority, 2011).

The use of Virtual Worlds is on the increase and the largest user group are under the age of 15 (Watters, 2010). The NMC Horizon Report: 2011 K–12 Edition (Johnson et al., 2011) identified that game-based learning will be adopted in K-12 schools within a two to three year time period. Current pre-service teachers will be tasked with implementing virtual worlds into schools in the time frame of the Horizon Report and thus it is important to gauge pre-service teachers’ current knowledge of the potential of curriculum-based virtual worlds and their attitudes to using them in their classrooms. This led the researchers to ask: What are pre-service teachers attitude about the potential and relevance of curriculum-based worlds for school education? The responses were analysed using the TPACK framework.

Research Context

This paper reports on research undertaken at the University of New England (UNE) as part of the Australian Teaching Teachers for the Future (TTF) project. This project was underpinned by the TPACK framework and aimed to improve pre-service teacher ability to implement effective use of ICT into the new Australian Curriculum. Prior to this, Fisher (2000) reported national concerns about the ability of pre-service teachers to integrate ICT effectively into the curriculum. Fisher recommended that pre-service teachers should be provided with the skills necessary for them to
perform their role as a teacher and therefore teacher educators need to understand pre-service teacher attitudes towards ICT as this will impact on whether they will then implement ICT into their teaching and learning.

Every Australian university offering pre-service teacher education was involved with the TTF project and each university was required to nominate two curriculum areas within which to increase targeted pre-service teachers exposure to ICT in designated units. Each university engaged the service of a project-funded ICT Pedagogy Officer (ICTPO) to assist teacher educators. UNE nominated science and mathematics as their designated curriculum areas. Only the science experience, involving embedding ICT into a secondary science methods unit, is reported here. Two science educators were involved in this implementation, only one of them taught in the unit.

The two science educators, in close consultation with the ICTPO, decided to implement a curriculum-based virtual world, *Quest Atlantis* (QA), as a core component of the unit in semester 2, 2011. The unit studied contained a mandatory QA quest, *Cinder Creek - Biological Indicators*, looking at water quality and an optional unit, *Taiga*, looking at issues with water quality and why fish are dying in the Taiga National Park (fictional). In addition, there were other ICTs incorporated including: *Google Documents*, *Skype*, *Spreadsheets*, and *Adobe Connect*. ICT components of the unit were delivered using *Adobe Connect* to demonstrate ICTs in practice and to experience the many modules of the virtual world.

Engaging in QA was a mandatory component of the outcomes, content, learning activities, and assessment. The pre-service teachers were also given the opportunity to become accredited QA teachers, enabling them to use QA in their classes upon graduation. This opportunity had never before been offered to pre-service teachers at any university in the world. There were approximately fifty off-campus pre-service teachers enrolled in the unit. They were required to complete reflections on TPACK and reflections on the use of virtual worlds in education, both before and after studying the unit, and to participate in QA from both a teacher and a learner perspective. QA was introduced to the science pre-service teachers in four, ninety minute workshops where they underwent the QA teacher accreditation course. The workshops were run by the UNE ICTPO (first author), an accredited QA Teacher Trainer. For the pre-service teachers to see value in curriculum-based virtual worlds they needed to not only use the teacher resources supplied within QA but also experience the range of options they could use in their own curriculum planning.

**Methodology**

One important strategy used to evaluate the effectiveness of the TTF project was to measure the impact of the changes implemented at each institution by compiling *Most Significant Change* stories. Stories in relevant curriculum areas were created separately for the teacher educator perspective and the pre-service teacher perspective and then the final (combined) stories for each curriculum area were shared nationally. Only relevant findings from the pre-service teacher science story are shared in this paper.

The pre-service teachers were interviewed as a focus group using the *Most Significant Change* story protocol provided by the TTF Project and developed by Davies and Dart (2007). After the researcher (ICTPO) recorded the interview a two-page story was created from the main points shared. Finally, the story was shared with the pre-service teachers to check the accuracy of representation. The story for the research reported here is about the learning that took place as the pre-service teachers changed their thinking about ICT whilst undertaking a unit of study where innovative ICTs had been the implemented.

The ICTPO interviewed four self-selected pre-service teachers in a focus group meeting using *Adobe Connect* (virtual classroom). The interview protocol addressed:
• development of their ability to use ICT in their teaching to improve student learning in effective and innovative ways;
• the learning activity that was most influential in developing their ICT proficiency;
• identifying the most significant change in their thinking about ICT and the activities that they participated in that contributed to that change;
• components in the unit that led to successful development of their ICT proficiency;
• ways in which they would use their new ICT skills in their future classrooms.

Each of these areas had sub-questions that focused the pre-service teacher discussion.

The focus group meeting was held after the pre-service teachers had submitted all assessment tasks. What they shared was compiled into a two-page story and then sent to each pre-service teacher to check that it was a true and accurate record of their combined story. Relevant changes were made and then the story was checked again by the pre-service teachers before being published (Doyle & Reading, 2012). Relevant comments about the components of TPACK, as well as explicit comments about initial reluctance to use ICT in teaching are reported in the results.

Results

The results are reported as pre-service teacher comments about reluctance, technological knowledge (TK), technological pedagogical knowledge (PK), and technological content knowledge (TCK). All four pre-service teachers expressed an initial reluctance to participate in the QA aspects of the unit. There were three main aspects of this reluctance: the mandatory nature of the virtual world component of the unit; the time that needed to be allocated to the activities (especially the imposition on their own time) and their opinion that this was just another meaningless online game. They associated experience with other online games with learner time not being well spent. One pre-service teacher noted that “games were often quick and short, meaning that learners only retained information for parts of the topic”. The consensus amongst all the pre-service teachers was that learners were not able to participate in and demonstrate any higher order thinking processes when using online games.

The technological knowledge (TK) developed by the pre-service teachers was evidenced in their developed awareness of how specific ICTs are used and their increased appreciation of the need for their students to have this knowledge. The pre-service teachers all agreed that QA was the most significant ICT that they had experienced in their course to date (all were in their last year of a four year equivalent full time degree). They believed that their involvement with QA was the most significant learning activity within the unit. The pre-service teachers all made mention of the range of interactive learning activities (quests and missions) that they investigated within QA in addition to the unit requirements. In particular, they mentioned the cybersafety quests as a “fun and engaging way” of introducing computers to their students. The pre-service teachers reported that Adobe Connect (virtual classroom) was the next most significant ICT. All pre-service teachers wondered why virtual classrooms were not used in other units to demonstrate new skills as they believed this enhanced their learning. One pre-service teacher noted that his “computer use had gone from 30% to 80%” and therefore there was an improvement in his ICT literacy. All the pre-service teachers expressed their awareness of their responsibility to ensure that their students are computer literate as this is a skill required to compete in a competitive job market.

The technological pedagogical knowledge (TPK) developed by the pre-service teachers was evidenced in their developed awareness of how: specific ICTs can suit different learning styles; QA scaffolding allows content to be customised to suit learner needs; and assessment can be embedded within the QA tasks. One of the pre-service teachers said she “sat and spoke to a student about it (QA) and they thought it was great that they could express themselves without having to act tough or in any manner that they would normally not act”. The pre-service teacher actually decided that she herself fitted into that category, explaining “I really enjoyed who I was in QA because I learnt to bring that person out in the real world” and “she could be herself and have fun and realised that this was how students feel when experiencing peer pressure”. This pre-service teacher developed an awareness that QA allowed
for the different learning styles of students. The pre-service teachers reported that the scaffolding provided within QA added value because it allowed them to see how teachers can either use the materials as supplied by the program or customise to suit individual learners. They found it especially useful to be able to experience the learner view as well as the teacher view. The pre-service teachers reported that the ability to incorporate assessment tasks within the virtual world or game was “tremendously helpful”.

The technological content knowledge (TCK) developed by the pre-service teachers was evidenced in their developed awareness of how: virtual worlds allow students to engage in situations and visit places that would not be possible in real life; students can see across time consequences of decisions; feedback can be used to alter the sequence content is presented to students; and content can be customised to suit the curriculum. The pre-service teachers indicated that QA allowed them to have their students engage in situations that would not be normally be possible due to cost or safety issues or to take their learners to places in the virtual world that they may not be able to visit in real life, due to the location or other circumstances. They considered it worthwhile that QA allowed the learners to see the “visible consequences” of their decisions thus learn about taking responsibility for their actions. The pre-service teachers collectively agreed that the ability of QA to allow learners to resubmit tasks after taking into account feedback was very beneficial to the teachers as it allows them to gain an immediate understanding of whether their learners, either individually or collectively, understand the underlying curriculum content of the activity. One pre-service teacher in particular felt that the training received on giving feedback will be useful when she is giving feedback to her own learners. The pre-service teachers noted that the ability to customise content within QA was valuable, as it gave them an opportunity to make any necessary content based adjustments to the United States of America written resources.

Discussion

Digital technology opens possibilities for children to carry out projects that are more complex and also far more connected to sophisticated powerful ideas than anything children could do in the past (Papert, 2001, p. 9).

A virtual world is an example of a digital technology that opens possibilities for learners to discover answers to complex problems where learners become members of a broader community and learn from one another (Bronack et al., 2008). This is epitomized in QA with the underlying model of transformational play built on the theory that learners can learn whilst playing games. The pre-service teachers in the focus group had a change in attitude from resistance, thinking that a virtual world only offered lower order thinking (skepticism), to advocacy, thinking that curriculum-based virtual worlds offer learners opportunities to engage in higher order thinking processes.

Clearly, before they had engaged with QA, the pre-service teachers demonstrated resistance in their attitude to the use of curriculum-based virtual worlds in science teaching. This was expressed in their reluctance to participate in the QA aspects of the unit and in their view it was justified because QA was mandatory; would take up too much time and that this was just another meaningless online game. Their initial view could be equated to not getting value for the time spent learning the new ICT.

As a result of the experience in QA, the evidence of development of the pre-service teachers’ TK, TPK and TCK clearly demonstrated a transformation of their attitude to the use of ICT, in particular curriculum-based virtual worlds, in science teaching. They became more aware of how ICT can be used and how specific ICTs can suit different learning styles. They particularly appreciated how the scaffolding in QA could be used to adjust content to suit learner needs and how content can be customised to suit the curriculum. Importantly, they were able to identify that virtual worlds allow students to engage in situations and to visit places that would not be possible in real life and also allow the students to experience across time consequences of their decisions. Finally, the pre-service teachers could see the advantages of assessment being embedded within the QA tasks and feedback on that assessment used to inform decisions about altering the sequence in which content is presented to students. The breadth of aspects of competence identified by the pre-service teachers as being
impacted by the use of ICT indicates that they had transformed from resistance to advocacy.

Such a transformation of attitude leads to the potential for pre-service teachers to be change agents; where they learn about or experience ICT and how it relates to pedagogy through their teacher training, thus improving their TPACK, and then they go on to implement these ICTs in their classrooms.

**Conclusion**

This research has clearly demonstrated how the pre-service teachers studying science education have changed their attitude about the use of curriculum-based virtual worlds in teaching. These results need to be considered carefully in the light of three limitations to this research. Firstly, there were only four (8% of cohort) pre-service teachers who participated in the focus group and thus their story may not accurately reflect the attitude of the cohort. Secondly, the TTF project restricted the *Most Significant Stories* to two pages and it is possible that consideration of the entire story would expose other changes in attitude. Thirdly, the *Most Significant Change* stories methodology focuses on capturing the positive aspects of the stories and not the negative (if any) (Davies & Dart, 2007, pp. 79-80).

There are implications of these findings for both teaching and research. There are two implications for teaching. Firstly, teacher educators should persist with embedding unfamiliar ICTs (including mandatory assessment) into teacher training, even if there is initial resistance to the idea, because exposure to the potential of the ICT will improve pre-service teacher TPACK. Secondly, pre-service teachers need to engage with new ICTs in their undergraduate training to better equip them with the knowledge to use their TPACK to effectively integrate ICT in their classrooms. Curriculum-based virtual worlds provide an ideal environment for such experiences because they integrate technology (virtual interactive environment) with content (curriculum-based quests) and pedagogy (engaging, immersive interfaces).

There are three main implications for future research. Firstly, there needs to be more published research into the use of curriculum-based virtual worlds in Australian classrooms so that pre-service teachers can be better informed about, and less resistant to, their use in teaching. Secondly, attitudes of larger groups of pre-service teachers need to be investigated to develop a more detailed story of how resistance can change to advocacy. Thirdly, more research is needed to investigate the unexpected finding that students in QA found it possible to be themselves and not subjected to peer pressure.

All the pre-service teachers in the focus group were transformed from a position of resistance to advocacy of the value of curriculum-based virtual worlds, realising that they had been given a unique opportunity to be part of this future of education. They all believed that there was a place for curriculum-based virtual worlds in pre-service teacher education.

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**References**


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