Engaging students in new technologies using a representation construction pedagogy

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Abstract

This presentation describes a case study of a pre-service secondary science teacher education curriculum course that was designed to embed ICT into its curriculum, assessment and delivery in terms of the tutor modeling best teaching practice in the use of learning technologies. The theoretical framework is Technological Pedagogical and Content Knowledge (TPACK) viewed through a representational construction approach that involves students undertaking a series of representational challenges whereby they construct and critique representations. These representations may include artifacts produced by learning technologies. In participating in the course, the study wished to determine the levels of pre-service teachers' engagement with ICT, and changes in their understandings of the ways in which ICT can be embedded into the teaching and learning of science. The study found student engagement with learning technologies and an enhanced TPACK over the period of the course. Some of the drivers for these findings were embedding ICT into the curriculum and assessment in addition to the competence of a skilled teacher educator modeling best practice in applying a representation construction approach. Further, the ICT tasks given to the pre-service teachers were seen as authentic in terms of highlighting how ICT might be used in a school environment. Some of the issues raised by the pre-service students in the course were the time commitment in completing some of the ICT tasks, access to digital resources outside the University and insufficient modeling of ICT practice in the students' non-science courses and practicum schools.

Hubber, P. & Loong, E. (in Press). Increasing Learner Engagement of Learning Technologies and Science TPACK through Representational Challenges, in C. Wankel & P. Blessinger (eds.) *Increasing student engagement and retention in e-learning environments: web 2.0 and blended learning technologies*. Bingley, UK: Emerald Publishing Group.

Introduction

Digital technologies in the classroom

- Government and Education System Level funding of ICT infrastructure
  - Laptop program for senior students
  - Fibre optic broadband rollout
  - Ultranet – online learning management system
- School-based initiatives
  - Whole school use of laptops/tablets
- Integrating ICT into the classroom is still challenging for teachers and lecturers
  - Lack of modeling of best practice for pre-service teachers (teachers and lecturers)
- Embedding ICT into pre-service teaching programs
  - Movement away from technology only courses
  - Need for pedagogies that support the integration of ICT

Case study

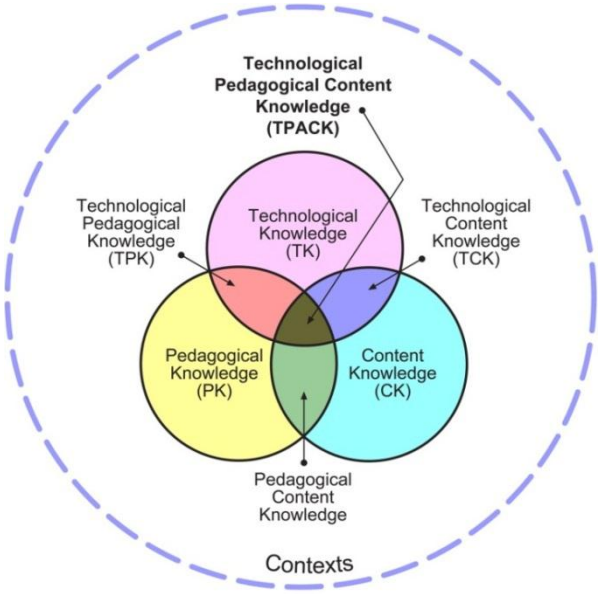
A case study of a pre-service secondary science teacher education curriculum course, titled ***Resources in the Contemporary Science Classroom***, which was designed to embed ICT into its curriculum, assessment and delivery in terms of the tutor modeling best teaching practice in the use of learning technologies.

Critical to the design of an ICT embedded teacher training course are the use of pedagogies that support the integration of ICT in a manner that makes them explicit to the pre-service teacher. That is, the key elements of the pedagogies are explicitly discussed whilst at the same time being modeled in the classroom.

The study involved an exploration of the pre-service students' engagement with learning technologies and Technological Pedagogical Content Knowledge (TPACK) in participating in the course.

TPACK: A Framework for Teacher Knowledge

A teacher requires content, pedagogical and technological knowledge in addition to a nuanced understanding of the interplays between these three sources of knowledge (Mishra & Koehler, 2006).



*A teacher has the intention of introducing the particle model to explain various properties of matter to her Year 7 class. She will need to have the necessary **content knowledge** of the particle model and possess **pedagogical knowledge** of the ways in which Year 7 students effectively learn abstract concepts, for example, how to conduct a role play to represent particle motion in a solid piece of matter. She may wish to elicit her students' prior views on the nature of matter using an online survey and so will require the **technological knowledge** to construct and administer the survey.*

Representation Construction Pedagogy

There is a growing consensus that quality learning must involve richer and more sustained reasoning and engagement with the mediating tools of the discipline in ways that entail the acquisition of a subject-specific set of purpose-designed literacies (Lemke, 2004; Moje, 2007). Students use the multi-modal representational tools of science to generate, coordinate and critique evidence (Ford & Forman, 2006), involving models and model-based reasoning (Lehrer & Schauble, 2006). A recent Australian Research Council (ARC) funded project, Representations in Learning Science (RILS), successfully developed a theoretically sophisticated but practical, representation construction approach to teaching and learning that links student learning and engagement with the epistemic (knowledge production) practices of science (Prain et al, 2010; Tytler & Hubber, 2011).

This approach involves challenging students to generate and negotiate the representations (text, graphs, models, diagrams) that constitute the discursive practices of science, rather than focusing on the text-based, definitional versions of concepts. The representation construction approach is based on sequences of ***representational challenges*** which involve students constructing representations to actively explore and make claims about phenomena. It thus represents a more active view of knowledge than traditional structural approaches and encourages visual as well as the traditional text based literacies. RILS has successfully demonstrated enhanced outcomes for students, in terms of sustained engagement with ideas, and quality learning, and for teachers' enhanced pedagogical knowledge, and understanding of how knowledge in science is developed and communicated (Hubber, 2010; Hubber, Tytler & Haslam, 2010). This representation construction approach shows promise of resolving the tension between inquiry approaches to learning science and the need to introduce students to the conceptual canons of science (Klein & Kilpatrick, 2010). It also shows promise in providing a wider pedagogical approach to embedding ICT into a teacher's classroom practice.

***A representational challenge:** Students are given the challenge construct a digital representation, using the animated feature of PowerPoint, that provides a particle model explanation of the observations that a cube*

of sugar appears to disappear when dissolved in hot water. Following the construction of the representations they are evaluated by the class in terms of their ability to use particle ideas to explain the given observation.

Resources in the Contemporary Science Classroom

This semester length course was delivered to a mixed cohort of pre-service secondary science teachers:

- 15 final year undergraduate double degree (Bachelors of Science & Teaching) and 13 postgraduate Master of Teaching students.
- 19 students in on-campus mode (workshop format) and 9 students in off-campus mode through a web-based online learning management system called *Blackboard* (http://www.blackboard.com/).

ICT was embedded into the curriculum, assessment and delivery of this course:

- Explicit discussion of TPACK framework and Representation Construction Pedagogy.
- A variety of digital resources (tools and devices) were trialed and evaluated in terms of their efficacy of use in school classroom.
- National professional standards for teachers – ICT elaborations.
- Incursions – expert teacher practitioners of ICT in the classroom; excursion to museum that makes effective use of digital technologies.
- A representational construction pedagogy that affords the integration of ICT into classroom practice was modeled in the classroom
- Representational challenges which were embedded in the weekly tasks (on-campus & off-campus) as well as the major assessment task, the digital portfolio contained in a website.
- Multiple roles of the Pre-service Teacher:
    - Learner
    - Teacher
    - Pre-service teacher

Examples of ICT representational challenges:

Students had the choice of undertaking one of four challenges: white coffee problem, adaptation challenge, light reflection challenge or hand motion challenge. After the completion of the challenge students were to present their findings to the rest of the class. In the white coffee problem students were challenged to use digital thermometers and other equipment to answer the question, 'if one has just poured a fresh brew of coffee and one can't drink for a few minutes should one add milk now or after two minutes?' For the adaptation challenge students were challenged to collect evidence of adaptation in two animals and present their findings in a Prezi (http://prezi. com/) presentation. For the light reflection challenge the students were to use digital light probes to determine which type of coloured paper other than white reflects the most amount of light. For the hand motion challenge the students were provided with a short video of a person walking and challenged to use motion analysis software to determine if a person's hand actually moves backwards when the person is moving in a forwards direction.

Key Findings of Case Study

The study found increased engagement of ICT tools and devices and increased levels of Technological Knowledge and TPACK among the students who participated in the course.

Drivers for pre-service teachers' engagement with learning technologies and increased TPACK

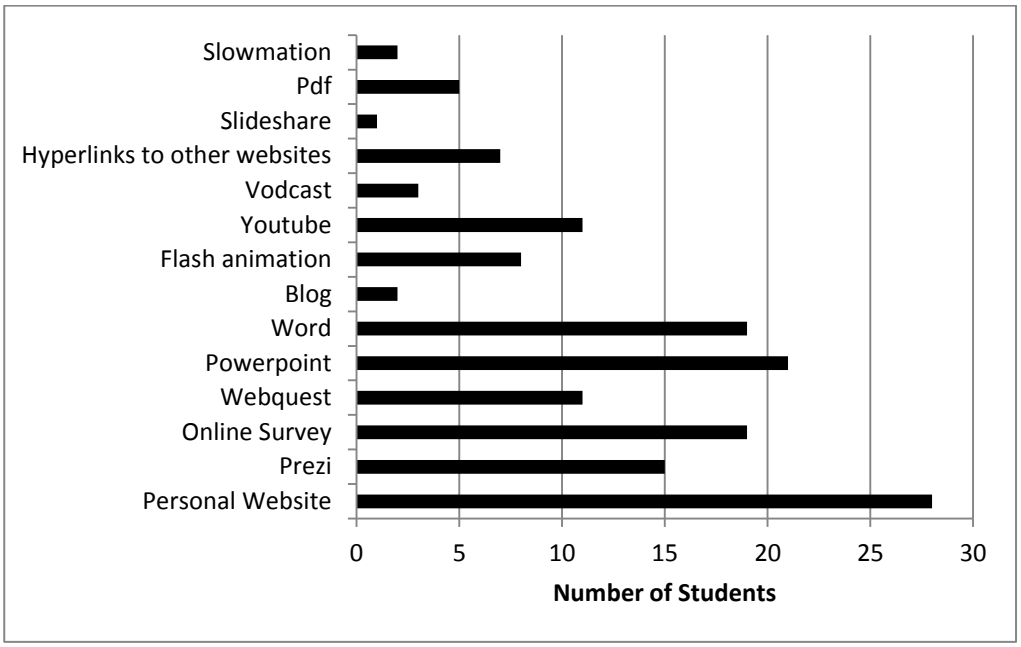
- The nature of the representational challenges and the expectation that they be completed as part of the general course work as well as an assessment requirement.
- The focus was not on the learning technology but on the outcomes of using the learning technology.
- The challenges represented activities that were set in the context of teaching and learning of science relevant to the students.
- The competence of a skilled educator modelling best practice in the ways in which ICT can be used in the science classroom.
- By taking on the multiple roles of learner, pre-service teacher and teacher during the course the students directly experienced a representation construction approach, which involves the student construction and critique of representational forms.

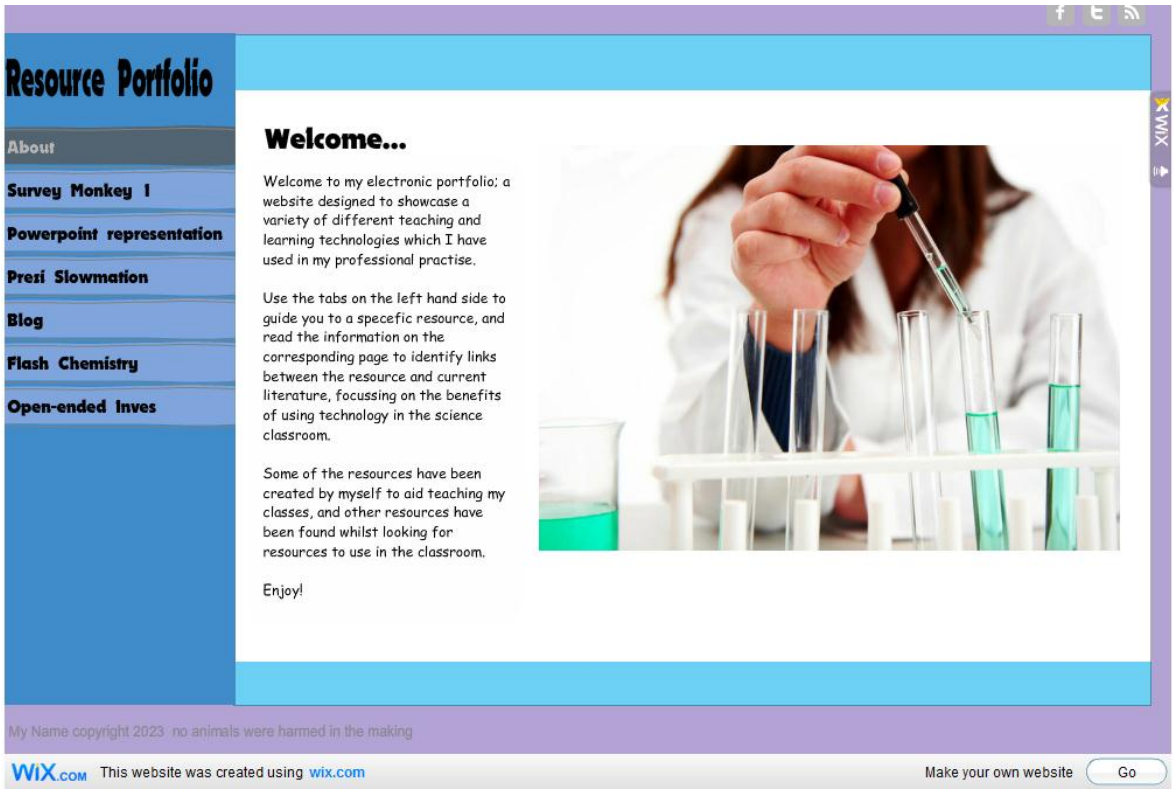
- The representational forms do not necessary imply the products of a learning technology and so the students saw the use of technologies within a broader pedagogy. In other words, a learning technology needs to be seen as a tool for learning rather than the technology as an end in itself.

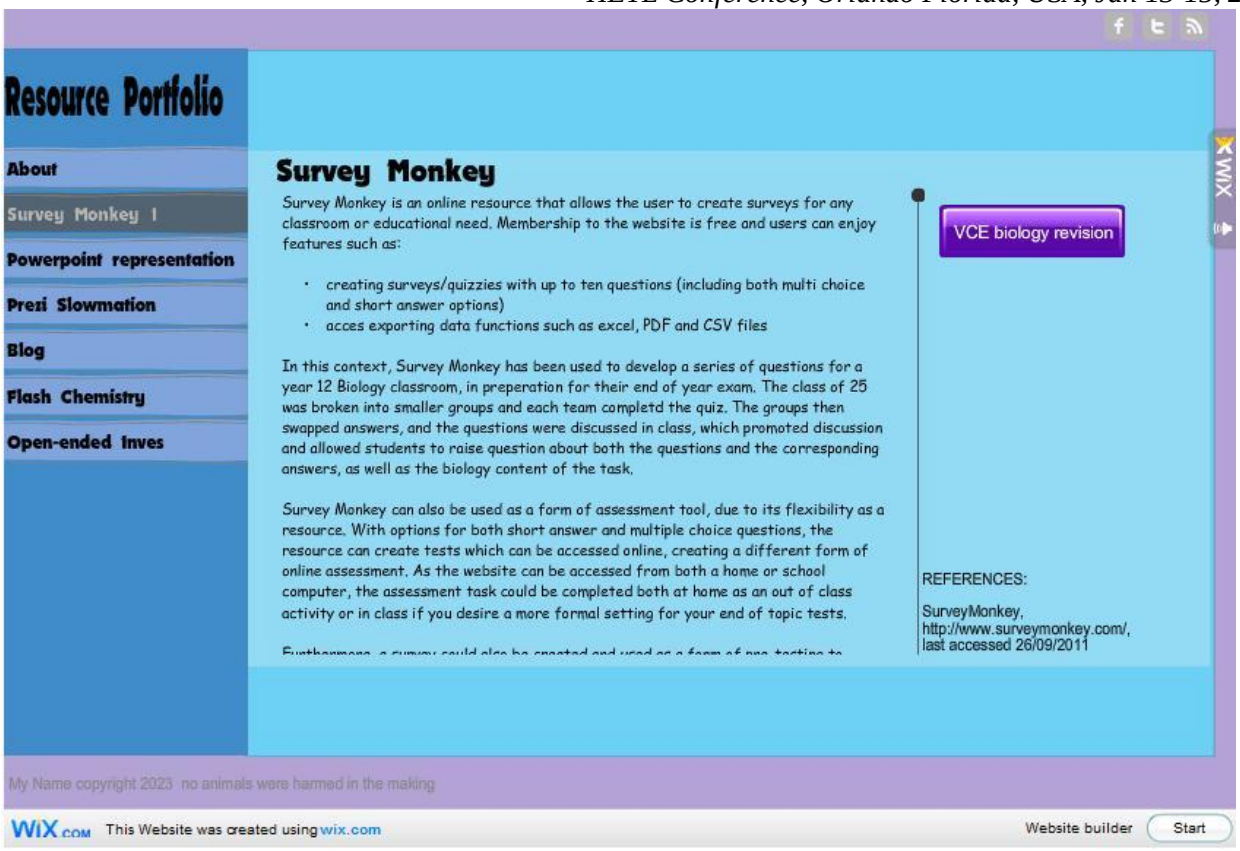
Barriers for pre-service teachers' engagement with learning technologies and increased TPACK

- General lack of models of best practice in either pre-service teaching program or practicum programs.
- The non-access to ICT system structures such as the Victorian government Schools' *Ultranet*. Teacher educators and pre-service teachers should be given access to the technologies they are likely to encounter in schools.

Digital portfolio – major assessment task for course







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