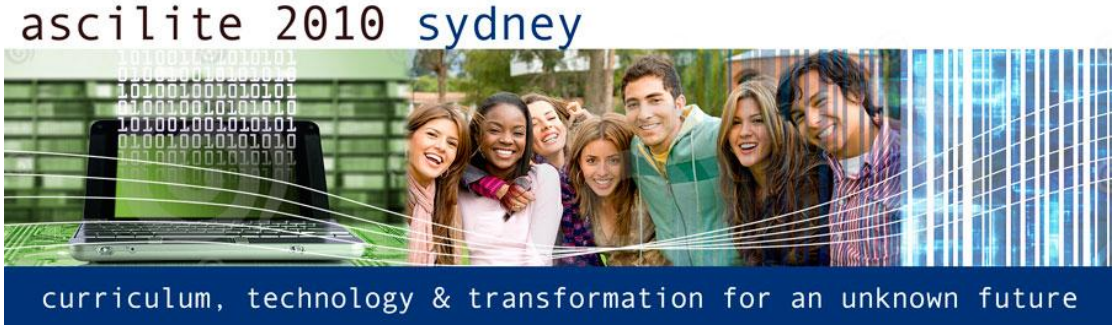

How do postgraduate students learn and integrate knowledge of the learning sciences?

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University students often face significant challenges both seeing connections between different conceptual ideas, and linking theoretical ideas with knowledge needed in their applied professional contexts. This paper presents some experiences and insights from a postgraduate course that was designed to support knowledge integration. It initially presents the main design ideas that have been applied in the unit. Then, it examines students' learning journals and explores how students integrated conceptual knowledge and experiences.

Keywords: knowledge integration, learning by design, student journals, higher education

Knowledge integration and professional learning

Studies in the area of the learning sciences have identified a number of challenges that students commonly face when building their coherent understanding about various conceptual phenomena. For example, studies conducted by Linn (Linn, 2006) have shown that students have a range of ideas about science concepts that they are learning. These ideas are often linked to students' experiences of phenomena in different contexts and are only loosely connected with each other (diSessa, 1993; Wagner, 2006). In short, students do not always see the fundamental similarities and differences between phenomena experienced in different contexts and instead interpret them as different or similar on the basis of surface features.

Students' challenges of knowledge integration and transfer have not only cognitive, but also epistemic roots. For example, some studies have shown that students generally possess many productive mental resources needed to understand physical phenomena, but they do not activate them in classroom setting (Elby & Hammer, 2010). Rather they tend to see learning of theoretical knowledge as different from other learning experiences and try to memorize this knowledge without attempting to make connections.

While studies on knowledge integration and transfer have been mainly conducted in the context of learning natural sciences, such as physics, students who study professional degrees face quite similar challenges. For example, research on preservice teacher education has almost uniformly reported that student teachers often do not see clear connections between conceptual knowledge learnt at university and their classroom practices (Torff, 1999). In the face of professional tasks and practical challenges during their practicums they tend to draw on their 'naive' commonsense conceptions of teaching gained before college, rather than on knowledge of psychology, pedagogy and cognate disciplines learnt at university. Novices in the area of technology-enhanced learning and instructional design face quite similar challenges. For example, it takes significant efforts for less experienced educational designers to concretize their design ideas and coherently apply abstract principles of instructional design in specific technology-enhanced projects (Ronen-Fuhrmann & Kali, 2010). A repertoire of design patterns and principles has been suggested to support knowledge integration (Linn & Elyon,

2006). Such principles include tasks that connect concepts with authentic problems, require students to collaborate, create and improve specific artefacts, reflect and monitor their understanding.

Study context and aims

The knowledge integration perspective and principles have been applied in the design of tasks and assessments in the course "An introduction to the learning sciences". This course is taught in the first semester of a postgraduate Leaning Sciences and Technology program. The course builds on work in the learning sciences (i.e., psychology, education, cognitive and neuro sciences) and seeks to introduce students to important conceptual frameworks that shed light on the relationship between technology and learning. The course is taught over 13 weeks period in a flexible delivery mode that combines two face-to-face sessions, weekly synchronous online classes, online group meetings and asynchronous tasks.

Sixteen students were enrolled in the course in the year of this study. During the semester students were presented with various class and synchronous online activities (e.g., concept mapping) and three assessment tasks (Table 1) that aimed to support knowledge integration. After the first half of the course students wrote an essay in which, building on their learning journals, they were requested to discuss links between key concepts learnt in the course, and their learning and professional experiences.

Table 1: Summary of the assessment tasks

Task	Description
Group innovation design report	A six week group project in which students explore existing pedagogical and technological innovations relevant to a chosen authentic problem and, building on some learning theories, suggest and design their own innovation.
Personal learning journal	Students apply the key concepts learnt during the first half of the semester for the analysis of their own learning and professional experiences.
Research project	A six week group project in which students learn some basic research techniques that are used in the learning sciences and jointly design and conduct a small-scale empirical study of an authentic learning issue.

In this study we aimed to explore and identify the main ways in which students integrated the conceptual ideas learned in the course and how they linked this knowledge to their learning and professional experiences.

Emerging findings and conclusions

Our initial analysis shows that students' integration of ideas varied along two key dimensions: (a) the balance between the theoretical and the practical and (b) the coordination between the abstract and the specific. Successful students presented more balanced and elaborated essays with either critical analysis of their experience using theories or critical analysis of theoretical concepts linking them to their authentic learning and job experiences. The coordination between the abstract and the specific ideas was also different. Some students started from broader conceptual or practical insights, but consequently narrowed down and illustrated them with specific examples. Whereas other students discussed ideas in general terms and, and while they linked theoretical concepts to their experiences, they gave very few examples. While some of these students focused on experiences, they nevertheless described them in general terms stating, for example, that technologies helped them to organize group work or that technical faults were the major barrier. These students not only provided few specific examples, but also little elaborated on their experiences (e.g., why it was so, how it could be applied in other contexts). Overall, our initial analysis indicates that not only the categorical difference between the theoretical ideas and practical experience, but also the hierarchical organization of knowledge and experience (i.e. abstract vs. concrete) might play a significant role in integrating conceptual ideas with practical understanding.

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