Mobile and Web 2.0 technologies in undergraduate science: Situating learning in everyday experience

Jenny Waycott and Gregor Kennedy
Faculty of Medicine, Dentistry and Health Sciences
The University of Melbourne

Mobile and Web 2.0 technologies have the potential to support learning that is situated in "real-world" contexts, dissolving boundaries between formal learning and social spaces. We describe a case study in which first-year students in an undergraduate chemistry course used digital cameras or camera phones to capture images that illustrated chemical processes in everyday life. They then shared these images with other students on the *Flickr* website. We present qualitative findings from the case study evaluation, identifying students' perceptions of the activity and their reactions to using everyday technologies in this formal learning setting. While the evaluation identified positive aspects of the photo sharing activity, it also revealed that many students did not see the relevance of the activity to their formal learning. The paper raises a number of issues about the challenges of incorporating everyday technologies, such as mobile and Web 2.0 tools, into higher education.

Keywords: Web 2.0, photo sharing, mobile learning, science education, situated learning

Introduction

As digital technologies have become more pervasive in students' everyday lives, many educational commentators have suggested they could be appropriated as useful learning tools (e.g., Selwyn, 2007; Sharples, 2007). These commentators offer compelling reasons for incorporating the technology-based tools students are said to use in their everyday lives into educational settings. For instance, tools such as mobile phones and social networking sites facilitate communication and enable learners to capture, create and publish information, thereby fostering the development of learning communities. This is particularly the case for Internet technologies typically labelled "Web 2.0" tools, such as blogs, wikis, and social networking sites. Given the social nature of these tools and the central role users play in creating and publishing the content on these sites, they clearly have potential to support student-centred approaches to learning (McLoughlin & Lee, 2008). Many commentators have also suggested that social software may be particularly useful for engaging the current generation of students, known as the "Net Generation," who, it is often assumed, are technologically-savvy "digital natives" (Barnes, Marateo & Ferris, 2007; Barnes & Tynan, 2007; Oblinger & Oblinger, 2005; Prensky, 2001).

However, caution must be exercised when implementing everyday technologies in formal learning settings. It is important that debates about the potential value of these technologies are grounded in empirical research that sheds light on how such tools can be best used to support learning. Decisions about using everyday tools in education should not be based solely on assumptions about the skills and experience of so-called Net Generation students. As Bennett, Maton and Kervin (2008) have demonstrated, assumptions about Net Generation students are typically based on conjecture and anecdotal accounts. Recent empirical research does not fully support the rhetoric that university students make up a distinct and homogenous group of digital natives with a vast array of skills and experience in using new technologies (Kennedy, Dalgarno, Bennett, Gray, Waycott, Judd, et al, 2009; Kennedy, Judd, Churchward, Gray & Krause, 2008).

It is important that researchers and practitioners who incorporate everyday or social technologies into educational settings evaluate and publish findings about the successes and challenges involved in order to build up empirical evidence about what works and what doesn't work. This paper aims to contribute to this empirical evidence by examining students' reactions to a novel learning activity in which everyday tools were used by undergraduate science students in an independent learning activity that involved capturing and sharing images of science in the everyday world. It is imperative that a sound pedagogical rationale drives the use of new technologies in formal learning settings. One potential educational benefit of using everyday technologies for learning is that they can support activities that take place beyond the physical confines of formal learning spaces, facilitating learning that is situated in the "real-world". In the following section we discuss the importance of situating learning in students' everyday experiences and describe how mobile and Web 2.0 tools can be used in this way, particularly for capturing and sharing images.

Using technologies to situate learning in everyday experiences

For many years, educators have acknowledged the challenge of fostering knowledge that learners recognise as meaningful and relevant to their everyday lives (Illeris, 2009). Part of the rationale behind educational theory's move towards more student-centred approaches is that often, historically, students were asked to study material that was abstract and not immediately relevant to their everyday experiences. While by its very nature higher education often requires students to develop an understanding of abstract notions and phenomena, many contemporary educational frameworks and models have suggested that such abstract concepts can be made more accessible – or meaningful to students – if they are placed in authentic contexts.

One of these frameworks is situated learning. Arguably most well known through the influential paper of Brown, Collins and Duguid (1989), as well as through the work of Lave and Wenger (1991), "situated learning" or "situated cognition" emphasises the need to place learners in real-life contexts. Brown, Collins and Duguid (1989) suggested that "useful learning" takes place when students are set authentic tasks in authentic contexts, noting that learning is intricately linked to how knowledge is used. They defined authentic activities as "the ordinary practices of the culture" (or profession) associated with the domain of knowledge being taught (p. 34). This framework has been influential in other practical conceptions of how to make students' learning experiences more authentic (see Herrington and Oliver's (1995) critical characteristics of situated learning). However, many educators faced with teaching core undergraduate disciplines may find it difficult to create situated learning experiences. The practical constraints of large class sizes – in some instances numbering over 1000 students – often make it untenable to place students' learning experiences in authentic contexts.

Engaging students in real-world activities that in some way represent the abstract concepts they are learning about in their undergraduate studies could provide a way of modifying and simplifying the notion of situated learning. While it may not be possible to create and administer truly authentic learning tasks, learning activities can be designed so that the concepts and principles being covered in the formal curriculum are made relevant in some way to students' everyday lives. In this way, students can be encouraged to reflect on their learning and consider how it relates to the world around them. This is particularly important for science education. Science learning involves developing knowledge about sometimes difficult and abstract concepts, which can be made more meaningful if learners are able to build connections between their formal knowledge and their personal experiences (Vavoula, Sharples, Rudman, Lonsdale & Meek, 2007). One way in which these connections can be fostered is by encouraging students to demonstrate their understanding of science in the real world by capturing and sharing digital images that illustrate scientific principles in action. Mobile technologies, in the form of digital cameras or camera phones, and photo sharing social software, such as *Flickr*, make it possible for photo sharing activities to be incorporated into the undergraduate science curriculum, as described below.

Mobile technologies

It is easy to see how technologies such as mobile phones could be appropriated as learning tools given their essential role of communication. In Australia, a majority of undergraduate students report having mobile phones with cameras (Kennedy et al, 2009), and many have phones that are web-enabled. This suggests that mobile technologies could be utilised for learning activities that not only ask students to access material but also involve capturing and sharing information online. In addition, mobile technologies are said to offer particular advantages for facilitating learning that occurs across contexts, given their affordances as personal and portable technologies that can be carried about and accessed anytime, anywhere (Sharples, 2000, 2007). For this reason mobile technologies are well placed to help learners create a link between science learning in the classroom and their experience in the world around them. As Scanlon, Jones and Waycott (2005) noted: "There is a synergy between what mobile technology can provide for learners and the needs of science learners in particular." (p. 4).

There have been a number of published case studies in which mobile technologies have been used to help students connect what they are learning in formal classrooms with what they experience outside the classroom. Many of these cases involve learning that takes place in museums and on field trips (e.g., Vavoula, Sharples, Rudman, Meek & Lonsdale, 2009). There are also many recent examples involving the use of digital cameras to capture information relevant to students' learning. For example, Lai and colleagues conducted a case study in which primary school students used PDAs with plug-in digital cameras to engage in an experiential learning activity in environmental science. Students used the cameras to record images of plants; this appeared to be a successful way of augmenting the learning activity (Lai, Yang, Chen, Ho & Chan, 2007). Uzunboylu, Cavus, and Ercag (2009) investigated the value of using mobile phones to engage students in learning about environmental issues. A group of volunteer students taking part in a summer vacation program used their own mobile phones with camera facilities to record images of local environmental blights. They used multimedia messaging (MMS) to send the photographs to a facilitator who then uploaded selected photos to the project website. Students shared comments about the photos, using SMS or email, and used their phones to participate in collaborative discussions about the issues raised. Findings from pre- and post-activity surveys suggested that students' environmental awareness increased significantly over the course of the program. The use of mobile phones to capture and share images has also been identified as a means of engaging teenagers in learning about science at a science museum (Bressler, 2006), and mobile phones have been used by student teachers to record events that occurred during practical placement assignments (Ferry, 2009). In this example, the recorded images later formed the basis of reflective discussions with other students.

Web 2.0 and photo sharing

While digital cameras and camera-enabled mobile phones can be used to capture information, Web 2.0 tools can be used to publish and share that information, facilitating collaboration and peer knowledge-sharing. There are numerous examples of informal communities of practice that have flourished through the use of social software and sharing information online. For example, craft enthusiasts share photographs and information about craft practices on the web (Torrey, Churchill, & McDonald, 2009), contributors to Wikipedia share their knowledge on a variety of topics (Bryant, Forte, & Bruckman, 2005), and young people have been identified as active participants in online interest groups catering to fan communities, gaming enthusiasts, and amateur writers (Ito, Horst, Bittanti, boyd, Herr-Stephenson, Lange, et al. 2008). Many commentators have suggested that the informal learning that occurs in these technology-mediated communities could be emulated in higher education settings, providing a bridge between social and formal learning spaces (Bull, Thompson, Searson, Garofalo, Park, Young & Lee, 2008; Greenhow, 2008; Selwyn, 2007).

Social software tools that enable users to publish and comment on user-created content include photo and video-sharing sites such as *Flickr* and *YouTube*. On *Flickr* users can establish, join, and contribute to private or public groups; people who have common interests can then share and comment on each other's photographs (Miller and Edwards, 2007). For instance, a group of urban residents might compare photographs of the same city, noting the changes that have taken place over time (see for example, Burgess, Foth & Klaebe, 2006). Photo sharing tools can also be used to facilitate informal communication and community development within a distributed workforce (see Thom-Santelli & Millen, 2009). In this way, sharing digital photographs online can provide a way for members of a community to come together and share experiences, creating common ground for further collaboration and community development. Collaborating and sharing information within communities of practice are key components of situated learning theories and are seen to be essential in creating authentic learning experiences (Brown, Collins & Duguid, 1989; Lave and Wenger, 1991).

The case study described below sought to investigate how mobile and Web 2.0 technologies could be used to help science students relate what they were learning in class to their everyday, out-of-class experiences. A further aim of the activity was to facilitate students' knowledge-sharing practices through the use of an online social software tool. Below, we describe the learning activity and the case study evaluation. The findings are then discussed with reference to the lessons that can be gleaned from this case study about the utility, relevance, and practicality of incorporating mobile and Web 2.0 technologies in higher education courses.

The chemistry *Flickr* project

The learning setting

The chemistry *Flickr* project was one of a series of case studies that were conducted as part of a large Australian collaborative project (see Kennedy et al, 2009). Eight learning activities involving the use of new technologies were implemented in different learning settings across three Australian universities. The chemistry *Flickr* project took place in first semester 2008 with students enrolled in first-year chemistry at The University of Melbourne. There were 920 students enrolled in the subject and 799 students took part in the activity. The activity was one of four independent learning tasks, which were hurdle requirements for the subject. That is, students needed to complete each independent learning task in order to pass the subject, although the tasks were not assessed. Independent learning tasks were new to the curriculum for this subject and lecturers felt the photo sharing activity would be an innovative way of engaging students in independent learning outside the classroom.

The learning activity

Subject lecturers, in collaboration with project researchers, designed the learning activity. The main objective of the activity was to encourage students to relate their formal learning about chemistry to their everyday lives. Students used their own digital cameras/camera phones in combination with the *Flickr* web site to record and share images that illustrated chemical processes in everyday life.

Students were asked to join a dedicated private group on the *Flickr* web site and publish at least two photographs to the site. Each student was given two topics (from nine topics covered in lectures) and asked to take photographs that illustrated those topics. They were also required to "tag" the images with appropriate keywords and to write a textbook-style caption, identifying how each image illustrated a chemical principle (see Figure 1). Finally, in order to encourage peer learning and knowledge sharing, students were asked to review other students' photographs and captions and to nominate the two best photos related to a specific topic. It was anticipated that this would enable students to share other students' broader experiences and perceptions of the subject. (For more information about the design of the learning activity see Kennedy et al, 2009).

Technologies used

Flickr was chosen from a small number of photo file sharing web sites that were considered. It enabled students to upload photos in a shared space, provided a reasonable level of control over individual and group access, allowed RSS feeds, and was backed by a large company (Yahoo). Students used their own digital cameras or camera phones. Previous research had shown that most undergraduate students had unrestricted access to these technologies (Kennedy et al, 2009). In order to ensure equity of access, however, the chemistry department purchased a small number of digital cameras that students could borrow for the purposes of the activity.

The evaluation

The evaluation of the activity focused on capturing students' reactions to the learning activity and the technologies used. Mixed methods were used to evaluate all the case studies for the project. Focus group sessions with students and staff elicited in-depth information about student and staff perceptions of the activity and the technologies used. For this case study, ten students took part in a single focus group session towards the end of semester. A focus group session was also held with four staff participants, and one staff member was also interviewed earlier in the project. Staff data, however, are not reported here (see Kennedy et al, 2009). In addition, activity logs, taken from RSS feeds, were used to monitor contributions to the *Flickr* group.

At the end of the activity students were invited to complete an online evaluation questionnaire, developed by the project team, based on Reeves and Hedberg's (2003) guidelines for effectiveness evaluation. A modified version of the questionnaire was used in each of the eight case studies for this project (see Gray, Kennedy, Waycott, Dalgarno, Bennett, Chang et al, 2009). Items asked students to rate (on five-point Likert scales) how well they believed the activity supported their learning; to indicate whether they had found *Flickr* easy to use; to identify the best and worst things about the activity; to suggest how it could be improved; and to indicate whether they would like to see the same type of activity used in other university subjects. There was a poor response rate to the questionnaire: of the 799 students who took part

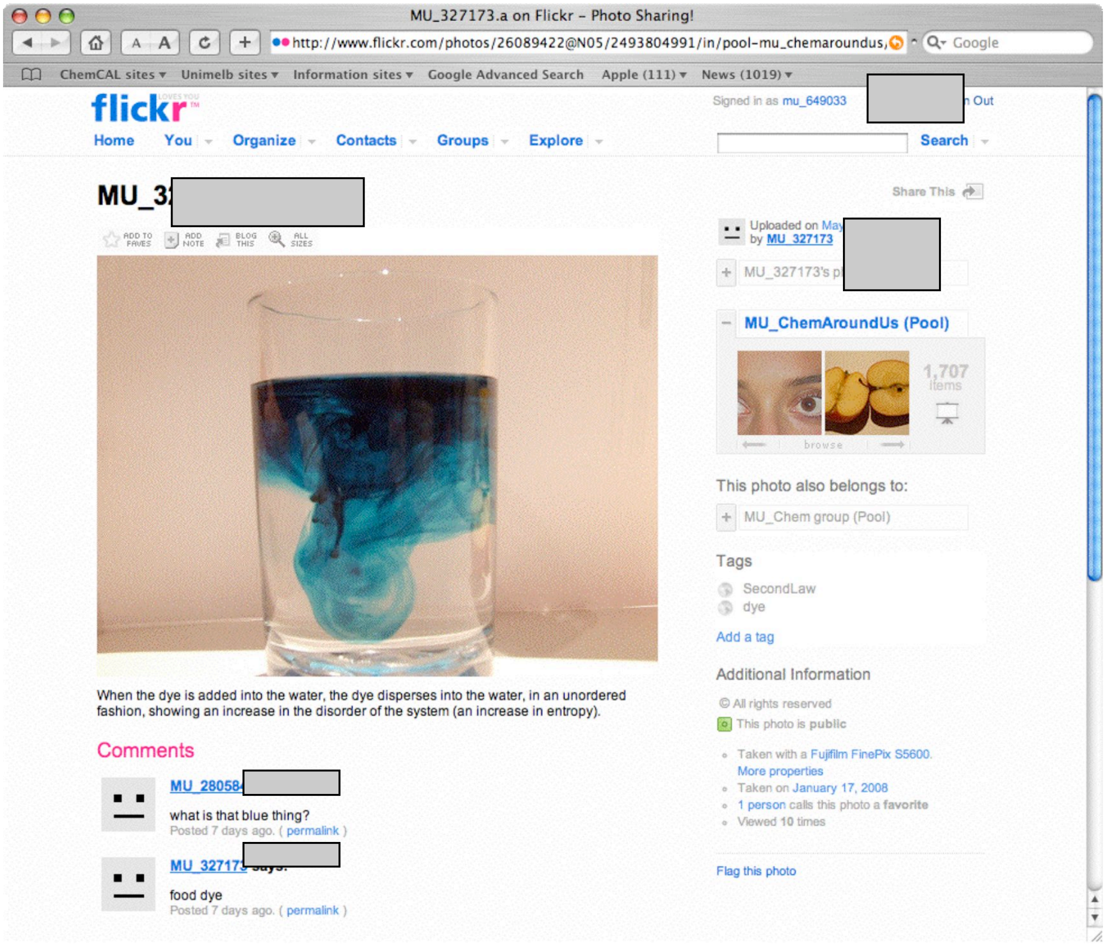

Figure 1: An example of a student photo illustrating entropy

in the activity, only 44 completed the questionnaire. This may have been due to the fact that completing the questionnaire was optional and it was administered outside of class time. Given this poor response rate, the chemistry department administered a follow-up questionnaire as part of its review of the curriculum (Abraham, Harvey, Chang, Kennedy & Tregloan, 2009). However, while more students responded to this questionnaire (N=465), the results were similar to our evaluation.

For the purposes of this paper, we have focused on the qualitative data collected from both students' responses to open-ended questions in the evaluation questionnaire, as well as their comments in the focus group session. These two sets of data were analysed together using *NVivo*, a qualitative analysis tool. The comments were coded into categories reflecting the main benefits and limitations that students identified in relation to how well they felt the activity supported (or did not support) their learning. In addition, in order to explore the appropriateness and utility of using everyday technologies in formal learning, comments that related specifically to the technologies used were coded into separate categories reflecting the main difficulties students experienced in using these technologies in this context. The discussion below identifies the main benefits and limitations of the learning activity and students' reactions to the use of everyday/social technologies in this setting. Where appropriate, quantitative data from the questionnaire findings are also reported, although it is difficult to make generalisations from these findings given the low response rate to the questionnaire.

Results and discussion

In all, 799 students participated in the activity, contributing 1894 photos to the *Flickr* site. A total of 4262 tags were added to the photos and only 45 photos were uploaded without a caption. The qualitative data from questionnaires and focus group discussions revealed a number of possibilities and constraints introduced by the learning activity and the use of mobile and Web 2.0 technologies, as described below.

How the chemistry *Flickr* activity supported students' learning

The online questionnaire asked students to indicate whether they felt the activity "helped me better understand the material I was studying." Most questionnaire respondents did not feel the activity supported their learning in this way: 68% disagreed with this statement. However, comments made in response to open-ended questions and in the student focus group discussion revealed that some students felt that there were positive aspects of the activity. The activity appeared to support students' learning by (1) providing them with a novel learning activity, (2) facilitating peer learning and knowledge sharing, (3) providing a link between formal learning about chemistry and the "real world", and (4) enabling mobile learning.

1. A novel learning activity
The most common positive response from students about this activity was that it was interesting and provided a welcome alternative to other more traditional exercises. According to one questionnaire respondent, it was good to be able to do something "outside the box." It provided a "more interesting way of viewing chemistry" and, in the words of another student, made a nice change from "diabolical multiple choice questions." These comments suggest that the activity had the potential to capture students' imaginations and engage them in an interesting and somewhat unusual learning task. However, the novelty of capturing and sharing images in this learning setting and the interest that this created for students is not a sufficient measure of the educational merit of using everyday tools such as digital cameras and social software in a formal educational setting. While the novelty of the activity may have provided, as one student suggested, "an interesting diversion," many students also raised questions about the relevance of the activity to their formal learning in this course (see below).

2. Peer review and knowledge sharing
When asked to indicate the best thing about the activity, several students commented on the learning benefits associated with being able to view other students' work. Using a photo sharing web site to store the photos and captions provided students with an opportunity to review and reflect on other students' work, promoting peer learning and knowledge sharing. One focus group participant observed "it's interesting to see other students' perspectives on your topic… You sort of looked at it and you're like 'oh, so that's what they thought' whereas I might have thought something completely different." Another student commented "there were some good photos in my review topic, and some explanations that were clear and concise on the topic and helped me to understand the concept." These comments suggest that there is potential value in using social Web 2.0 technologies to facilitate peer knowledge sharing. As noted above, the knowledge sharing aspects of Web 2.0 technologies mean they offer particular benefits for facilitating the development of communities of practice and many informal learning communities have been seen to flourish using social networking and file sharing tools. According to social learning theories, communication and peer review within learning communities are key components of learning (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991). Being able to publish and share information within a diverse learning community, then, clearly has the potential to support students' learning. However students in this case study also noted some reservations about this aspect of the activity, as discussed below.

3. Bridging formal learning and the "real world"
In line with the educational objectives of this project, some students felt that the activity successfully enabled them to link their formal learning about chemistry to the "real world" around them. One student suggested that this was a particular problem for science learning that the activity helped to resolve: "with chemistry and probably other sciences as well [they] can be quite abstract at times; it was good to actually put it into reality." Another student suggested that linking concepts to the real world provided particular learning benefits: "I think learning by analogy is very, very helpful. So if you go out there and find an example of something and then you're always going to be able to refer to that later." These comments align well with the notion that mobile and Web 2.0 technologies can be used to situate students' learning activities in real world contexts that make the abstract concepts they are covering more accessible and meaningful.

4. Mobile technologies enabled mobile learning
One of the key characteristics of this activity was that it involved students undertaking an independent learning task in their own time and beyond the physical confines of the formal education institution. Using their own mobile technologies – digital cameras or camera phones – students could engage in this activity "anytime, anywhere". While respondents to the online survey did not comment on this aspect of the activity, during the focus group session there was a lengthy discussion about the positive aspects of undertaking a learning activity using mobile technologies. As one student noted:

> I liked the fact that you could access it from anywhere. So it meant that if you had your camera with you or like a camera phone or something and you're at a friend's house, you can quickly upload the picture and put it on without having to be at uni or be at home on your computer. You could do it from really anywhere.

Other participants related how they had incorporated the learning task into their everyday activities. For instance, one student said she took one of her photos while on a hiking trip, while another took a photo on the train. Being able to capture images using technologies that were always available, then, made it easier for the learning activity to be situated in students' everyday experiences.

Limitations of the chemistry *Flickr* activity

In the online questionnaire students were asked to indicate what they *didn't* like about the activity. Responses to these questions, along with comments made during the focus group discussion, were categorised into a number of themes that revealed the main reservations students had about the chemistry *Flickr* activity. The four key limitations that emerged from students' perspectives were: (1) the activity was irrelevant and time consuming, (2) it did not support learning, (3) other students' work was sometimes of poor quality, and (4) there was great repetition in the photos posted to the *Flickr* group. Each of these is discussed briefly below.

1. Irrelevant and time consuming

Many students questioned the relevance of the photo sharing activity. The following comment captures the sentiment that was expressed by a number of students in the questionnaire responses: "I unfortunately failed to see the point [of this activity]. After discussing it with other students, I found that they thought similarly of the exercise. It seems an unnecessary and unhelpful hurdle that will not actually teach us anything practical."

Despite comments suggesting the activity was "pointless," most students did seem to appreciate the main objective of the activity. The questionnaire asked students to indicate, in their own words, what they believed to be the purpose of the activity and responses typically showed that students believed the purpose was to integrate their formal learning with their everyday experience. For example, the activity was said to be designed "to allow us to apply our knowledge of chemistry and our understanding of it to the world around us, to take it from theory and into practice." However, there were some students who believed the technology itself formed the main focus of the activity, with comments such as: "[The purpose was] to integrate IT and chemistry" and "to make us use technology." In line with this sentiment, some students felt the activity was primarily about taking photographs, rather using digital images as a way of reflecting on the relevance of their learning to the everyday world. One student questioned "why do we need to take photos and upload them?" and another student commented "I signed up for chemistry, not photography!!!"

Closely related to questions about the relevance of the activity, students also complained that the activity was too time-consuming, taking time away from other more high-priority tasks, such as preparing for exams: "I thought I could have used my time more effectively, for example I could've been revising the examinable material rather than mucking around trying to upload some photos." This comment was echoed by a number of students in their responses to the questionnaire, with complaints such as "I feel that it's a waste of time" and "I don't have 35 hours in my day".

2. Limited support for learning

Similarly, many students suggested that the activity did not contribute sufficiently to their learning in this course. As noted above, most questionnaire respondents felt the activity did not help them better understand the material they were studying. This was reflected in a number of comments that students made, such as: "It didn't really aid any understanding of the course" and "I learnt about one little topic, not all the others." Again, the issue of time taken away from other learning activities was central to students' complaints: "I did not find it useful in any way, or that it contributed at all to my studies. If anything, it took time away from them."

3. Poor quality of other students' work

In contrast to the benefit of peer learning and knowledge sharing outlined above, many students suggested that the poor quality of other students' work meant this aspect of the activity was not as valuable as it might have been. Students said that some of their peers appeared to misunderstand the instructions and made mistakes in the way they described their photographs: "there were wrong/misleading descriptions of a concept." Poor quality images also made it difficult to gain value from reviewing other students' work:

“they're usually non-professional photos and can be dull.” In the focus group discussion, one student commented “a lot of [the photos] are very blurry … You can’t see what they’re taking a photo of.” Other students suggested this may have been due either to students’ skills in using cameras or limitations in the technologies used: “Maybe they had bad camera phones”.

This theme provides a clear counter argument to the often mentioned affordances of Web 2.0 technologies associated with user-created content and knowledge sharing. While clear benefits can arise from students creating and sharing their own content, in an educational context students may have concerns about the authority or veracity of the material. If students feel that the content that is being created and distributed in their peer network is of poor quality, this may undermine their confidence in the activity and their ability to engage and learn from it.

4. Repetition of photos
Students also complained that there was a lot of repetition in the photos uploaded to the *Flickr* group: “everyone ended up doing similar pictures” and “there were too many pictures to go through in *Flickr* when reviewing”. This again highlights a potential limitation of using Web 2.0 technologies in education settings, particularly in courses with large student numbers. If students are required to create and share content on the web in relation to a particular learning topic that content will inevitably be repetitive, making it difficult – and disengaging – for students to review each others’ work.

Technology limitations

Students identified a number of specific limitations relating to the technologies used. The two main limitations identified were that (1) students found it difficult to learn to use *Flickr*, and (2) having access to the technology was sometimes a problem. Both these issues, which are elaborated below, question assumptions that have been made about the utility and validity of using everyday and social technologies in formal learning settings.

1. Learning to use Flickr
The questionnaire asked students to indicate how much experience they had had with *Flickr* prior to participating in this activity. Only five respondents (13.2%) said they had had “quite a lot” of experience, while most respondents (73.7%) said they had not had any experience with this technology at all. These responses raise questions about assumptions that are often made about the technological experience and expertise of current university students (see Bennett et al, 2008; Kennedy et al, 2008, 2009).

Students were also asked to indicate whether they had experienced any problems using *Flickr* and if so to describe the nature of those problems. The results suggested that many students found it difficult to learn to use *Flickr*. For instance one student “didn’t know how to join the group or to upload pictures or link them to the group.” These problems were “resolved … by asking friends.” Another student said “I did not know how to get access to other people’s upload photos to comment on” while another suggested that it “just didn’t really make sense, so I got a friend to explain it”. These comments reveal that students relied heavily on their own social networks for support in overcoming technical difficulties, rather than using the technical support that was made available through the chemistry department.

2. Access to technology
For some students, having access to the technologies was a problem that inhibited their ability to undertake this activity in a timely manner. Access issues related to both the use of *Flickr* and digital cameras. Some students did not have a suitable Internet connection at home and had to use university resources: “I don’t have the fastest internet connection at home. I had to transfer my photos to a USB then bring it to uni and upload from there.” Similarly, another student commented, “[I wasn’t] able to do it from home as the computer is getting old”.

Others said they did not have a digital camera or camera phone, and that it was difficult to arrange to borrow a camera: “some people don’t have cameras and booking one is inconvenient.” In the focus group session, one participant said “I don’t think everyone actually owns a camera. I actually had to borrow my friend’s, which is lucky that a friend would have a camera but like in some weird kind of situation you might not have anyone who [has access to] a camera.” The chemistry department anticipated this problem and purchased digital cameras for students to borrow; however no students made use of these cameras. The focus group discussion revealed that students were hesitant about borrowing expensive equipment from the university. They felt limited by having to pre-book the cameras and only being able to borrow them for a short period of time. They were also concerned about learning to use an unfamiliar piece of equipment: “you might not know how to use it, especially if you don’t actually own a camera and you might never have used one before in that way." Again, these comments raise questions about assumptions that are often made about the technical skills and experience of so-called Net Generation students. These findings suggest that educators cannot assume that all students will have access to, and know how to use, the technologies that are often believed to be an integral part of students' everyday lives.

Conclusion

This paper reported on a project that incorporated mobile and Web 2.0 technologies into a large undergraduate chemistry class with the aim of situating the concepts students were learning about in class in the "real world". Despite a low response rate for the questionnaire, the qualitative data from the evaluation provided some valuable insights into students' perceptions of the learning activity and the technologies used. Some of the students who participated in the evaluation felt the activity was worthwhile and they benefited from relating what they were learning formally to their everyday experiences. There were also benefits associated with students sharing knowledge with their peers. However, students also expressed concerns that raise questions about the appropriateness of the learning activity and the technology that was used to support it. For some students, the relevance of the activity to their formal learning was not immediately apparent. This may have been because the activity, although a hurdle requirement, was not formally assessed and students felt it took time away from their assessment-focused tasks. There were also concerns about the quality and repetition of student work published on the *Flickr* site, which could indicate general perceptions from students that peer learning and knowledge-sharing can be problematic. Some students also encountered difficulties in accessing and using the technologies. While mobile and Web 2.0 technologies clearly have the capacity to support a range of novel learning tasks that may benefit students, educators should not assume all students will see everyday technologies as relevant and easy to use in a formal learning setting.

The issues raised by this case study suggest that care should be exercised when everyday or social technologies are appropriated for learning. While technologies such as mobile phones, digital cameras, and social networking sites may be prominent in students' social spaces, harnessing these tools for use in students' learning spaces may not be straightforward or unproblematic. It appears that the blending of social and formal spaces for learning may not always be desired or welcomed by students. However, there is clearly educational merit in situating students' learning in their everyday experiences, particularly if students are encouraged to reflect on their learning and to appreciate how the concepts they are learning about in class relate to the world around them. This form of situated learning can be made possible by using social and everyday technologies such as mobile phones and Web 2.0 tools, as this case study has demonstrated. The evaluation presented in this paper has offered some insight into the challenges involved in using these tools in higher education, shedding light on the many practical and pedagogical challenges associated with incorporating mobile and Web 2.0 technologies in a large undergraduate course.

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References

Abrahams, C., Harvey, S., Chang, R., Kennedy, G. & Tregloan, P. (May, 2009). *The Chemistry Flickr Project.* Paper presented at Educause Australasia 2009. Perth Australia. [Viewed 16 Oct 2009] http://www.caudit.edu.au/educauseaustralasia09/program/abstracts/tuesday/Peter-Tregloan.php

Barnes, C., & Tynan, B. (2007). The adventures of Miranda in the brave new world: Learning in a Web 2.0 millennium. *ALT-J, 15*(3), 189-200.

Barnes, K., Marateo, R. C., & Ferris, S. P. (2007). Teaching and learning with the net generation. *Innovate, 3*(4). http://www.innovateonline.info/index.php?view=article&id=382

Bennett, S., Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775-786.

Bressler D. (2006) Mobile phones: A new way to engage teenagers in informal science learning. In J. Trant and D. Bearman (Eds.). *Museums and the Web 2006: Proceedings, Toronto: Archives & Museum Informatics* http://www.archimuse.com/mw2006/papers/bressler/bressler.html [Viewed 9 June 2009]

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Bryant, S.L., Forte, A., & Bruckman, A. (2005). Becoming Wikipedian: Transformation of participation in a collaborative online encyclopedia. In K. Schmidt, M. Pendergast, M. Ackerman, & G. Mark (Eds.) *Group'05: Proceedings of the 2005 International ACM SIGGROUP Conference on Supporting Group Work* (pp. 1-10). New York: ACM Press

Bull, G., Thompson, A., Searson, M., Garofalo, J., Park, J., Young, C., & Lee, J (2008). Connecting informal and formal learning: Experiences in the age of participatory media. *Contemporary Issues in Technology and Teacher Education, 8*(2), 100-107.

Burgess, J., Foth, M., & Klaebe, H. (2006). Everyday creativity as civic engagement: A cultural citizenship view of new media. In *Proceedings of Communications Policy & Research Forum, Sydney.* http://eprints.qut.edu.au/ [Viewed 27 June 2009]

Ferry, B. (2009). Using mobile phones to enhance teacher learning in environmental education. In J. Herrington, A. Herrington, J. Mantei, I. Olney, & B. Ferry (Eds.), *New Technologies, New Pedagogies: Mobile Learning in Higher Education* (pp. 45-55). Wollongong: University of Wollongong. http://ro.uow.edu.au/ [Viewed 13 June 2009]

Gray, K., Kennedy, G., Waycott, J., Dalgarno, B., Bennett, S., Chang, R. et al (2009). *Educating the Net Generation: A Toolkit of Resources for Educators in Australian Universities.* Sydney: Australian Learning and Teaching Council. http://www.netgen.unimelb.edu.au/outcomes/toolkit.html

Greenhow, C. (2008). Connecting informal and formal learning experiences in the age of participatory media: Commentary on Bull et al. (2008). *Contemporary Issues in Technology and Teacher Education, 8*(3), 187-194.

Herrington, J. & Oliver, R. (1995). Critical Characteristics of Situated Learning: Implications for the Instructional Design of Multimedia. In J. Pearce & A. Ellis (Eds.) *Learning With Technology* (pp. 235-262). Melbourne: The University of Melbourne. http://www.konstruktivismus.uni-koeln.de/didaktik/situierteslernen/herrington.pdf [Viewed 12 Aug 2009]

Illeris, K. (2009). Transfer of learning in the learning society: How can the barriers between different learning spaces be surmounted, and how can the gap between learning inside and outside schools be bridged? *International Journal of Lifelong Education, 28*(2), 137-148.

Ito, M., Horst, H., Bittanti, M., boyd, d., Herr-Stephenson, B., Lange, P. G., et al. (2008). *Living and Learning with New Media: Summary of Findings from the Digital Youth Project*. Chicago: The MacArthur Foundation. http://digitalyouth.ischool.berkeley.edu/files/report/digitalyouth-WhitePaper.pdf [Viewed 12 Aug 2009]

Kennedy, G., Dalgarno, B., Bennett, S., Gray, K., Waycott, J., Judd, T., et al (2009). *Educating the Net Generation: A Handbook of Findings for Practice and Policy.* Sydney: Australian Learning and Teaching Council. http://www.netgen.unimelb.edu.au/outcomes/handbook.html

Kennedy, G., Judd, T., Churchward, A., Gray, K., & Krause, K.-L. (2008). First year students' experiences with technology: Are they really digital natives? *Australasian Journal of Educational Technology, 24*(1), 108-122. http://www.ascilite.org.au/ajet/ajet24/kennedy.html

Lai, C.-H., Yan, J.-C., Chen, F.-C., Ho, C.-W., & Chan, T.-W. (2007). Affordances of mobile technologies for experiential learning: the interplay of technology and pedagogical practices. *Journal of Computer Assisted Learning, 23*, 326-337.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge; New York: Cambridge University Press.

McLoughlin, C., & Lee, M. J. W. (2008). Mapping the digital terrain: New media and social software as catalysts for pedagogical change. In *Hello! Where are you in the landscape of educational technology? Proceedings ascilite Melbourne 2008*. http://www.ascilite.org.au/conferences/melbourne08/procs/mcloughlin.pdf

Miller, A. D., & Edwards, W. K. (2007). Give and take: A study of consumer photo-sharing culture and practice. In B. Begole, S. Payne, E. Churchill, R. S. Amant, D. Gilmore & M. B. Rosson (Eds.), *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 347-356). New York: ACM Press.

Oblinger, D. G., & Oblinger, J. L. (Eds.). (2005). *Educating the Net Generation*: EDUCAUSE. http://www.educause.edu/educatingthenetgen/

Prensky, M. (2001). Digital Natives, Digital Immigrants. *On the Horizon, 9*(5).

Reeves, T. C., & Hedberg, J. G. (2003). *Interactive Learning Systems Evaluation*. Englewood Cliff, NJ: Educational Technology Publications.

Scanlon, E., Jones, A. & Waycott, J. (2005). Mobile technologies: prospects for their use in learning in informal science settings. *Journal of Interactive Media in Education 2005*(25) http://jime.open.ac.uk/2005/25

Selwyn, N. (2007). *Web 2.0 applications as alternative environments for informal learning – a critical review.* Paper presented at the OECD-KERIS Expert Meeting. http://www.oecd.org/dataoecd/32/3/39458556.pdf [Viewed Aug 11 2009]

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & Education, 34*, 177-193.

Sharples, M. (2007) Introduction to Special Issue of JCAL on Mobile Learning, *Journal of Computer Assisted Learning, 23* (4), 283-284.

Thom-Santelli, J. & Millen, D. R. (2009). Learning by seeing: Photo viewing in the workplace. In S. Greenberg, S. E. Hudson, K. Hinckley, M. R. Morris, & D. R. Olsen, Jr (Eds.) *CHI 2009 Digital Life New World: The 27th Annual CHI Conference on Human Factors in Computing Systems* (pp. 2081-2090) New York: ACM Press.

Torrey, C., Churchill, E.F., & McDonald, D.W. (2009). Learning how: The search for craft knowledge on the Internet. In S. Greenberg, S. E. Hudson, K. Hinckley, M. R. Morris, & D. R. Olsen, Jr (Eds.) *CHI 2009 Digital Life New World: The 27th Annual CHI Conference on Human Factors in Computing Systems* (pp. 1371-1380). New York: ACM Press.

Uzunboylu, H., Cavus, N., Ercag, E. (2009). Using mobile learning to increase environmental awareness. *Computers & Education, 52*(2)*,* 381-389.

Vavoula, G., Sharples, M., Rudman, P., Lonsdale, P. & Meek, J. (2007). Learning Bridges: A role for mobile technologies in education. *Educational Technology,* 47, 33-36.

Vavoula, G., Sharples, M., Rudman, P., Meek, J., & Lonsdale, P. (2009). Myartspace: Design and evaluation of support for learning with multimedia phones between classrooms and museums. *Computers & Education, 53*(2), 286-299.

Authors: Jenny Waycott: jwaycott@unimelb.edu.au; Gregor Kennedy: gek@unimelb.edu.au

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