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Reflections on interactive classroom mLearning and the experiential transactions between students and lecturer

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This paper seeks to address a major deficit in understandings of mobile learning, that is, its lack of a solid theoretical foundation. An overview of existing theoretical concepts of mobile learning is presented, followed by an analysis of interactive classroom systems and the learning that they provide. The implementation of a specific interactive system *mInteract* in the lectures of a large accounting subject is described. *mInteract* is a Web-based system using no-to-low cost data-packet technology and provides for interactions from students' own Internet-enabled mobile devices. The paper examines, by means of reflections from the lecturer and students, the learning which took place during the implementation. The analysis demonstrates that interactive mobile learning can be interpreted using experiential learning theory, and that both students and lecturers engage in experiential learning. Furthermore, they enter into transactions of knowledge which are facilitated by the mobile learning system.

Keywords: mLearning theory, interactive classroom, experiential learning, transactional learning model

Introduction

Despite the enormous growth in interest in mobile learning (mLearning) over the last decade, there remains a serious gap in our theoretical understanding of the learning processes involved. Without this theoretical foundation, we lack sound criteria against which to evaluate the various types of mLearning activities in terms of how, or indeed if, they support high quality learning.

An example of the problems that may be encountered is lecture podcasting. This has been one of the most widely adopted forms of mLearning, both overseas and in Australia (McGarr, 2009; Laing, Wootton & Irons, 2006; Belanger, 2005; Townend, 2005). Its acceptance derives from its similarity to established educational forms, such as lectures and the provision of downloadable materials on eLearning websites. In addition, the apparent ease with which teachers can generate podcasts using audio recorders and commonly available free compression software adds to its popularity. However, podcasts of lectures generally represent a one-way, solitary and non-interactive mode of study which repeats the old didactic transmission model of education (Nataatmadja & Dyson, 2008; Dyson, Litchfield, Lawrence, Raban & Leijdekkers, 2009). Properly evaluating mLearning activities, such as podcasts, against sound educational theoretical paradigms is essential if we are to avoid repeating the mistakes of the past and so improve the learning outcomes of our students.

The aim of this paper is to contribute to the building of a theoretical basis for mLearning by analyzing another common mLearning application, that of interactive classroom systems. These involve the use of mobile devices to engage students in lectures by inviting them to respond to questions or undertake other learning activities, such as crossword puzzles (Goh & Hooper, 2007). The students are then provided with feedback, often in the form of bar graphs compiled by the system from the collated answers of the class. These interactive systems recast an otherwise usually passive, teacher-centred instructional situation (where the lecturer talks and students listen) into a more active learning process. The attention span and motivation of students improves and lecturers can adapt their content to the needs of students (Scheele, Wessels, Effelsberg, Hofer & Fries, 2005).

A variety of technologies have been developed for this purpose (Fies & Marshall, 2006). The most frequently used have been Personal Response Systems and clickers (or keypads), which students are normally issued with by their university (Draper & Brown, 2004). To reduce the cost of buying clickers (currently about $30 each in Australia), and to eliminate logistics and security challenges with the issue and return of the devices, and technical problems reported with software installation, researchers have increasingly considered making use of student-owned devices. Some lecturers have asked students to use their mobile phones in class to send their answers via SMS (Scornavacca, 2009), although others have found the cost of text messages, though relatively small, has discouraged students (Lindquist, Denning, Kelly, Malani, Griswold & Simon, 2007).

To avoid this difficulty and reduce costs to a minimum, the authors have developed the *mInteract* system, which allows students to respond via the Internet using their own Internet-enabled devices. These could be a mobile phone, laptop, PDA (Personal Digital Assistant) or iPod. With this online system, there is normally a small data-packet transmission charge to the student of 1-3c per interaction, depending on the activity, although if the student connects to the university wireless network, they can participate at no cost.

mInteract was implemented in the lectures of a large introductory accounting subject in our Business Faculty in the second half of 2008. Formal reflections by the lecturer, kept by means of regular emails to other members of the development team, and reflections by students in the form of anonymous discussion board contributions, furnish the source for our analysis of the nature of learning which took place in the subject using the *mInteract* system. This provides the material for our examination of the theoretical basis of interactive mLearning. Moreover, we believe our results from the use of *mInteract* would apply equally to learning using clickers or interactive SMS systems.

The paper examines the theoretical analyses of mLearning that have been undertaken to date. We then discuss experiential education, which will form the core theoretical underpinning of our own discussion, although we also draw upon other theories where they are useful in explaining what is happening in a lecture where mLearning is being used to enhance interactivity. Finally, we analyse the reflections on the use of interactive mLearning from our implementation and how this form of learning fits with experiential theory. We demonstrate that *both* students and lecturer engage in experiential learning. Furthermore, we show how their learning interacts and these interactions can be interpreted using Itin's (1999) transactional model of experiential education.

Theorizing mLearning and the interactive classroom

Some early writers saw mLearning as a mere extension of eLearning. For example, Quinn (2000) defined it as 'elearning through mobile computational devices'. As Laouris and Eteokleous (2005) note, this view ignores the fundamental differences between the two technology-assisted learning spheres. For them, eLearning is still compatible with classroom education, and is more formal, usually dependent on a fixed terminal and reliant on text and simulations. By contrast, mLearning calls for an 'environment and time independent pedagogy', is more informal and spontaneous, and lends itself to situated learning in real-life settings (Laouris & Eteokleous, 2005, p. 3).

Sharples, Taylor and Vavoula (2005) share the same focus on mobility and context in what represents the most serious attempt to date to develop an overarching theory of mobile learning which might distinguish it from other forms of learning. They propose four principles that they believe provide the foundation of mobile learning theory: 1. Learners are always on the move; 2. A great deal of learning happens outside the classroom; 3. Effective learning is learner-centred and collaborative, based on a sound foundation of knowledge and supported by formative assessment; 4. Mobile devices are practically ubiquitous. A point they insist on is that it is the '*learner that is mobile, rather than the technology*' (Sharples, Taylor & Vavoula, 2005, p. 3). This focus, however, steers away from the use of mobile technologies by students seated in a classroom and is not helpful in understanding interactive classroom learning.

A more effective consideration of interactive classroom systems is Sharples' (2003) application of the idea of conversations to mLearning. Originally developed by Pask (1976) and adapted to eLearning by Laurillard (1993), conversational learning theory focuses on the construction of conversations between learners, between teacher and learner, conversations within the heads of learners as they interrogate concepts, and conversations with the world (Sharples, 2003). Another way of looking at conversational learning is Kukulska-Hulme and Traxler's (2005, p. 34) concept of 'discursive interactions', which can be contrasted with the traditional delivery of content by teachers, with little room for conversation. For joint exploration to take place, Sharples (2003, p. 506) notes the importance of creating a shared framework:

> Central to these learning conversations is the need to externalise understanding. To be able to engage in a productive conversation, all parties need access to a common external representation of the subject matter that allows them to identify and discuss topics.

Interactive classroom systems provide this precursor to conversation as they involve the open display of class results, which permit both students and teacher to register the degree of consensus, as well as allowing students to compare their individual response with the whole class response (Draper & Brown, 2004).

Another useful concept for examining interactive classroom systems is that of affordance. This term refers to the way in which the design of an object naturally invites a user to interact with it in a particular way (Gibson, quoted in Lai, Yang, Chen, Ho & Chan, 2007). Lai, Yang, Chen, Ho and Chan (2007) note the affordances of mobile devices, such as PDAs, to make information available to learners wherever and whenever they require it, and to provide learners with multimedia 'note-taking' functionalities, such as photography, audio and video recording. They demonstrate how mobile devices can be used for educational activities which support experiential learning.

Herrington and Herrington (2007, p. 7) also note the affordances provided by mobile technologies, for example, 'as tools for complex and sustained tasks and problem solving' rather than for simple transmission. They list a number of possibilities offered by mobile devices to support authentic learning activities, including the use of the multimedia capabilities of mobile devices for developing digital narratives, the gathering and analysis of field data, concept mapping, and student-generated podcasts.

To the affordances highlighted by these authors, we can add that mobile devices offer the affordance of communication. Different devices provide a variety of channels of communication, including infrared transmission (used by clickers), SMS, and packet-transfer technology (used by *mInteract*), and these form the basis of interactive mLearning in the classroom and a necessary component of learning conversations. As Herrington and Herrington (2007) point out, these affordances mean that mobile technologies have the ability to support good quality learning as defined by the various educational theories that emerged in the twentieth century, displacing the old didactic, teacher-centred paradigm.

One of the earliest attempts to identify existing educational theories that are applicable to mLearning was undertaken by Naismith, Lonsdale, Vavoula and Sharples (2004, p. 10) They classified mLearning activities according to six categories, which consisted of three theories of learning (behaviourism, constructivism and situated learning) and three 'areas of learning' (collaborative learning; informal and lifelong learning; and learning and teaching support). Despite the fact that their classification is one of the most often quoted (see, for example, Watson & White, 2006; Herrington & Herrington, 2007), it fails to recognize many other significant learning theories of the twentieth century, such as Kolb's (1984) experiential learning, critical learning theory (Freire, 1972) or andragogy (adult learning) (Knowles & Associates, 1984).

Within their schema, Naismith, Lonsdale, Vavoula and Sharples (2004) place interactive classroom systems in the behaviourist paradigm. Behaviourism derives from Skinner's work on operant conditioning, where rats learn the correct response to set stimuli following repeated exposure, with associated reinforcement via rewards and punishments (Skinner, 1968). Naismith, Lonsdale, Vavoula and Sharples (2004, p. 2) link classroom response systems using mobile technology with previous computer-aided Learning (CAL), stating that both involve:

> the presentation of a problem (stimulus) followed by the contribution on the part of the learner of the solution (response). Feedback from the system then provides the reinforcement.

They see interactive classroom systems as facilitating whole-class drill and classify the technology used as personal and individual. This is certainly a feature of many CAL systems, where often individual learners sit at a computer repeatedly working through exercises until they have mastered the content. However, these authors ignore the collaboration required by students in interactive classroom mLearning to produce a joint class display of answers. Furthermore, in our implementation, the lecturer normally used each question only once, with *occasionally* a question being repeated. With most questions being single events, the drill aspect was absent and the opportunity for behaviour modification via repeated exposure to stimuli was lacking. Again, as Laouris and Eteokleous (2005) have pointed out, we must be careful to distinguish mLearning from the eLearning which preceded it.

Experiential learning and experiential education

In order to examine the learning that occurred during our implementation of the interactive classroom, we found that experiential learning theory was a useful tool, providing a greater degree of interpretative power than any of the theories quoted above. We therefore present an overview of this theory before describing the *mInteract* study.

According to experiential learning theory, the individual's active experience is the primary driving force from which learning comes (Kolb, 1984). The person discovers their own knowledge from direct practical experience rather than learning about something by listening to someone else, such as a teacher. The transformative experience is normally interpreted as action in a real-world context, but activities in the classroom and in learning simulations have also been demonstrated to result in experiential learning (see, for example, Kay & Dyson, 2006).

Kolb's theory has its roots in Dewey's (1963) learning by doing. An essential step in Dewey's philosophy of education is the need for the learner to reflect on each experience, that is, to derive understanding from doing. So, too, in Kolb, reflection is necessary if the learner is to make sense of their experience. Kolb (1984) defined the Experiential Learning Cycle as consisting of the following four phases:

1. *Concrete Experience*: the learner undergoes an experience of their own.
2. *Reflective Observation*: the learner reflects on their experience and relates it to their personal understandings.
3. *Abstract Conceptualization*: from this reflection, the learner abstracts concepts or applies existing theory.
4. *Active Experimentation* (or *Application*): the learner tests their new conceptual understanding by applying it in practice. This in turn leads to new concrete experiences as the next cycle of learning commences once again.

Whether all students go through the complete cycle will depend on the depth of their reflection about their experience. The cycle should be seen, therefore, as an ideal of learning rather than what is achievable by every student undertaking a learning experience created by their teacher.

Itin (1999) has built on the work of Dewey, Kolb, Freire and others to focus on an additional dimension of experiential learning. More particularly, Itin is interested in experiential *education*, that is the system of learning, teaching, the subject, and the institutional setting in which the student's learning of the subject occurs. This system is 'transactive' in nature, that is, there is an interaction between learners, between learner and teacher, between learner/teacher and the subject, and between the learner/teacher and the learning environment. Moreover, all of these interactions are transactions, involving an exchange of knowledge. They also represent valid experiences that take place in the subject. Students learn from their teacher, teachers learn from students, students and teachers learn from their environment, but also affect the environment.

Itin is not prescriptive with respective to teaching strategies, as long as they take advantage of as many transactional experiences as possible. With respect to lectures Itin (1999, p. 96) states:

> Lecturing and explaining would be legitimate teaching methods as long as the teacher is utilizing experience, the transactions available, and other elements of the philosophy (e.g., Does the lecture set the student up for a service-learning experience? Are students given an opportunity to interact in relation to the content presented?).

However, Itin (1999) notes the difficulty of teacher's creating meaningful transactions with students in large classes, as well as the lack of familiarity that students have with an educational approach that requires their active participation. Interactive classroom systems using mobile technology may well be a valid way of overcoming these hurdles in courses where student demand and institutional priorities mean that large lectures are a reality.

The *mInteract* system and its implementation in a large accounting subject

mInteract was developed in late 2007 and trialled in one lecture before its implementation in the subject 'Accounting for Business' in 2008. This is a large subject and involved the presentation of 3 identical lectures to a total of 450 students each week. Prior to class, the lecturer accessed the web interface of the system to set up interactive learning activities from his computer. Activities using *mInteract* can include multiple-choice or yes/no questions, questions requiring a number or text-based answer, peer evaluations of students' work (e.g., voting on student presentations or posters), posting questions to the lecturer during class, multiple selection from a list (e.g., student selection of topics they wish to study in the subject), and batteries of questions to be answered at the one time (e.g., a quiz or survey). For the most part, the accountancy lecturer used multiple-choice questions, with some questions requiring a number to be calculated from the accounting equation and a couple of text-based questions. He usually presented about 3 questions each week for the students to answer, but also tried more or fewer questions at times.

During the lecture, students with Internet-enabled devices were asked at intervals to go to the *mInteract* website and anonymously answer a question simultaneously displayed on the PowerPoint slide and on the screen of their device. The lecturer was disappointed to find that on average only about 15% of the class answered via *mInteract*, with a maximum of 33% electronic participation. In the first week of using *mInteract* he noted in his reflections:

> The good news is the technology worked perfectly - by Friday's lecture it only took me a few minutes to set up … The bad news is the level of participation (I was devastated) [Lecturer Reflection 1]

Various reasons were given by students when asked why they were not logging on: some did not have smart phones; some were put off by concerns over cost as they believed that *all* Internet use on mobile phones was very expensive; some did not know how to log onto the Internet as they hadn't done it before or were not aware whether their mobile phones were Internet-enabled. One part-time student, who had implemented a similar system in his job recently, confirmed in a discussion board contribution that probably the last two reasons were predominant:

> What we found was not reluctance to use the internet over mobile devices, but the understanding of the service. … we found that most of the users did not know their device had wireless data or that they didnt know how to use it. [Student Reflection 1]

However, the majority of the students who did not use their phone, laptop or PDA to answer engaged in a show of hands, often with their heads down so that they would not be influenced by the vote of others. Significantly, the use of *mInteract* in the lecture generated a great deal of interest in the questions beyond what one might expect by these more traditional methods alone.

Answers from those who had used *mInteract* were collected by the system and displayed to the class when the lecturer felt that most people had had time to respond. In the case of the multiple choice questions, the displays took the form of a bar graph, easily allowing all students in the class to compare their own answer – either the answer they had entered into the *mInteract* system, voted for by raising their hand, or silently noted in their head. The lecturer could then discuss the results with the class. If no lengthy discussion of the material was needed, the whole activity from display of the question, answering, and display of results would take no more than two minutes.

Reflecting on the transactional process of experiential learning between students and lecturer

Students' perceptions: Classroom interaction and improved feedback

Given that the majority of students answered the questions, either electronically using *mInteract* or by show of hands, we can conclude that on the whole they displayed a great deal of interest in the interactive activities introduced via mobile technology. Analysis of the student contributions to the discussion board confirmed this and reveals that the ability to apply their knowledge was important:

> I personally like the concept. I honestly don't follow accounting easily so having these multiple choice questions right after we've learnt something to allow us to apply what we've learnt is really helpful becuase I don't really follow the examples in the lecture slides becuase they've been done for us already. [Student Reflection 2]

The dominant message that came through from the discussion board was that students liked the timely feedback the system provided. This included feedback from the lecturer but also, interestingly, feedback from other students:

> I love the idea of answering questions and getting an idea of where i am in regards to other students and finding out instantly if i'm going along the right track with my studies. [Student Reflection 3]

Some students realized that the interaction was a two-way process. They received feedback from lecturer and peers, and the lecturer could track how they were going in building their understanding:

> If more and more people begin to use this service, the valuable information provided could be an ideal measurement on how the student's knowledge is progressing. ie, are they on track with this concept? [Student Reflection 4]

From these student comments, we can gain some comprehension of how the traditional lecture has been transformed using interactive mLearning (see Figure 1). The increased level of interactivity afforded by *mInteract* allows students to apply their knowledge by responding to the lecturer's questions, measure their performance against their peers and receive feedback from the lecturer. The lecturer, in turn, interacts by posting questions and discussing the results. The flow of information, as indicated by the arrows in Figure 1, is no longer one-way. We have moved from a didactic teaching environment, where the focus is on content delivery, to a more interactive teaching and *learning* environment, where the importance of understanding is enhanced. Collaborative learning is an essential part of this as students' individual responses are collected by *mInteract* to build the collective class response displayed in the graph. Even the students who did not participate electronically are part of this learning process and the shared 'conversation': the student who contributed Student Reflection 2 (above) was one of those who benefited from the activities even though they did not use their smart phones because of perceived cost issues. Student Reflection 4 acknowledges that the learning is not restricted to the students but that the teacher also learns in this interactive space.

Lecturer's perceptions: A transaction in learning

The reflections maintained by the lecturer over the semester reveal his conviction that the students had received an enhanced learning experience from the implementation of interactive classroom learning in the subject. This was, in fact, the expected outcome. In a perhaps overly critical response to Student Reflection 2 from the discussion board, the lecturer noted the superiority of learning through interaction over learning from the lecturer's slides:

> A comment ... about not bothering to follow lecture examples in the PowerPoint printouts but taking notice of the question I put up is the whole idea behind this trial. [Lecturer Reflection 2]

While the amount the students learnt through interactive mLearning may not have been surprising, what did amaze the lecturer was how much *he* learnt from using *mInteract*:

Yesterday almost no one got the right answer to Q1 - it is the most difficult journal entry they do in the subject - but it got me thinking - why didn't they understand it - the mInteract question gave me the opportunity to re-teach the answer - so during the day I added a slide after the question that explained how I calculated the answer (not really hard I thought) but then I received about 5 questions in class about the way I calculated the answer. Extraordinary amount of feedback. [Lecturer Reflection 3]

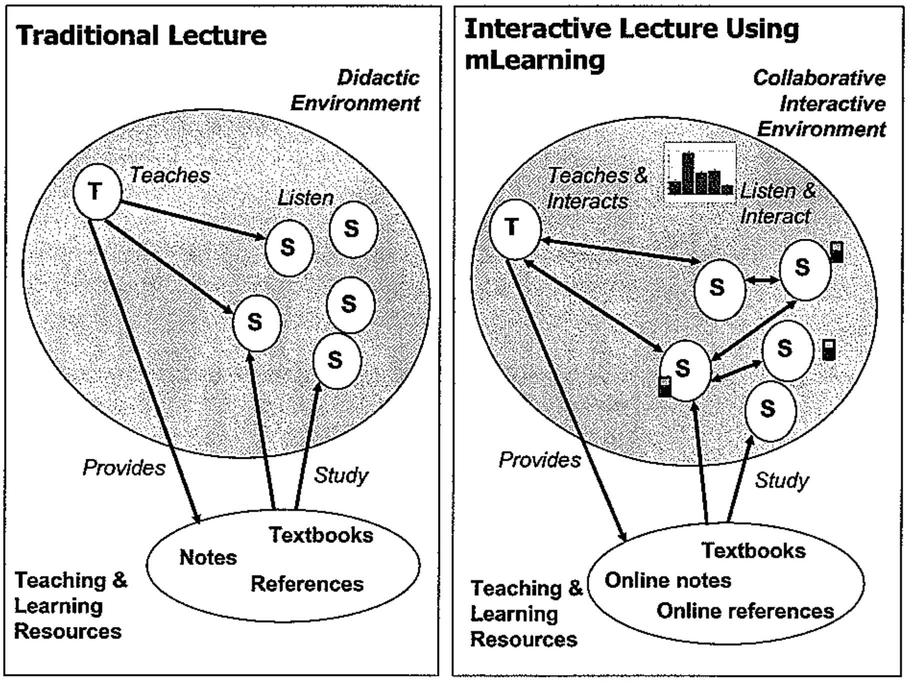

Figure 1: Comparison of traditional lecturing and interactive classroom mLearning

The lecturer's thinking had completely turned around from believing that the system was for the students (see Lecturer Reflection 2 above), to realizing that probably the greatest learning provided by *mInteract* was for him:

> Good feedback on what students don't understand - don't seem to be listening. … I initially thought this was for the students but now realize that it is for the teacher - a very useful learning tool for me. [Lecturer Reflection 4]

The reflections also reveal the added value of technology-assisted interactivity as opposed to traditional methods such as a show of hands, even when these were made anonymous by asking students to lower their heads while voting:

> mInteract results don't always correlate with a blind [heads down] class vote. The mInteract votes are hard - what people really thought - whereas the show of hands are soft. [Lecturer Reflection 5]

The lecturer felt he could trust the results produced by *mInteract* to inform him about the state of students' learning in a way he couldn't with traditional methods. Moreover, the graphical display encouraged students to ask more questions when they didn't understand:

> In previous semesters when teaching the same journal entry [see Lecturer Reflection 3], realising it was a difficult area I had always asked 'did everyone understand that - would anyone like me to explain it again' - never a response - students individually are reluctant to say they do not get it - they think they are the only one - but when they see the result of the responses graphically shown, they are much happier to ask when they know the vast majority also don't understand. [Lecturer Reflection 6]

Another interesting progression in the lecturer's thinking about the use of mobile technology in the lecture theatre occurred over the semester. In a response typical of many teachers and educational institutions (Sharples, 2003), the lecturer had previously treated connectivity in the classroom as a threat to learning. However, over the semester he became convinced that connectivity would be beneficial in supporting classroom systems, like *mInteract,* which allow student interactions through either a mobile service provider or through a wireless network:

> Wireless access in lectures is a controversial issue. Up to this point I have been concerned if access was available students would spend the lectures surfing the net (and I know some do this already). Now of course I would like to open it up. [Lecturer Reflection 7]

The lecturer's reflections, combined with student reflections on the discussion board, clearly demonstrate that the interactive classroom has become a site of experiential learning transactions. Our interpretation of how the lecturer and student both progress through most phases of an experiential cycle of learning is shown in Table 1 and as follows:

1. *Concrete Experience* (or *Action)*: For both, the cycle of learning begins with an active experience – for the lecturer, the design and activation of an interactive mLearning activity; for the student, participation in the activity, usually in the form of a response to a question.
2. *Reflective Observation* (or *Reflection)*: Again for both, reflection is triggered by the display of class results. Lecturer Reflections 3 and 4 demonstrate this reflective process happening in the lecturer ('it got me thinking - why didn't they understand it'; 'don't seem to be listening'), while Student Reflection 3 shows the student considering how their answer compares with that of their peers. The capture of the class response by *mInteract* makes it easy for both lecturer and students to examine and reflect, compared with a show of hands.
3. *Abstract Conceptualization* (or *Abstraction)*: For the lecturer, his Reflection 3 demonstrates a re-evaluation of how the material should be taught, which may involve a level of abstraction, although this is unclear from the reflections. Student Reflection 3 also seems to indicate an engagement with the theory or concepts taught in the subject ('finding out instantly if i'm going along the right track').
4. *Active Experimentation* (or *Application*): Through the lecturer's learning he was clearly able to rework his explanatory material (Lecturer Reflection 3). The fact that results are captured permanently by the system has an advantage for lecturers when revising teaching material between classes. None of our student comments provide support for this stage, so we can only surmise that students will apply their new learning in a context supplied by the subject or in their work.

Table 1: The interplay of the experiential learning cycles of teacher and student

Experiential Learning Theory	*Teacher Experience*	*Student Experience*
Action	Designs ***mInteract*** activities and deploys in class	Actively responds to ***mInteract*** questions
Reflection	Reflects on display of student results – *"Why didn't they all get it?"*	Reflects on display of student results – *"How does my answer compare?"*
Abstraction	Rethinking of teaching strategy	Confirmation or rethinking of theoretical understanding
Application	Redesign of teaching strategy with further explanation to students	Application of new understandings in assignments, exams or work

It is obvious, both from the reflections and Table 1, that the interactions taking place in the lecture represent transactions between students, and transactions between lecturer and students. The graph provided by the mLearning system, opens a mutual window to understanding for both students and lecturer or, in Sharples' (2003) terms, a basis for conversation, allowing these transactions to occur.

They are transactions in that they represent exchanges of knowledge (Itin, 1999). Students enter into a transaction with their peers by contributing to the joint class response and then comparing their own answer with this combined response as shown in the graph. The lecturer and students enter a complex series of interlocking transactions, beginning with the lecturer's posting of the activity, the students' response to this, and then learnings that begin with reflections on the displayed response. Through the lecturer's learning, he was able to enhance the knowledge of the students by adding another slide showing how he calculated the answer, which in turn stimulated extra questions and interaction with the students (Lecturer Reflection 3). In Figure 2 we have represented the experiential learning cycles of both student and teacher intersecting to show the transactive nature of their learning.

Conclusion

The most significant realization to come out of our first full-scale implementation of *mInteract* was that an interactive classroom system can transform a didactic teaching environment into one which supports transactional experiential learning. Furthermore, interactive mLearning is not just for students but also for the lecturer.

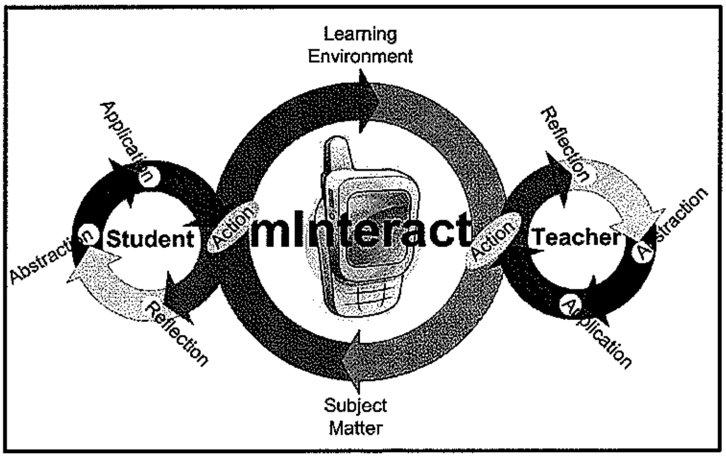

Figure 2: A transactional model of experiential interactive mLearning

Interactive mLearning is experiential in that *mInteract* allows lecturers to undergo an experiential learning cycle of their own, which runs in parallel and interacts with the students' cycle of experiential learning. Both lecturer and students are engaged in active learning experiences (Phase 1 of the experiential learning cycle), which are followed by reflection upon those experiences (Phase 2). The graphical display of combined student answers by *mInteract* provide the foundation for reflection for both parties. The comments by the lecturer demonstrated that, at least in his case, application of the new learning (Phase 4) then followed as he rethought his teaching strategy. More assessment would need to be done to demonstrate that students were able to apply their learning after reflection, although one student did talk about applying knowledge learnt in the previous part of the lecture when answering the *mInteract* questions (Student Reflection 2).

We can reasonably assume that these results would apply to other types of interactive classroom systems. For example, Draper and Brown (2004) are very clear about the ability of clickers to support adaptive teaching, whereby the lecturer's teaching strategies depend upon the students' current state of understanding. For them, the use of interactive classroom systems is 'about having what individuals think and do affect what others consequently think and do' (Draper & Brown, 2004, p. 92). They postulate that the interactivity provided by clickers impacts not only on a student's thinking and reflection, but also the teacher's ability to adapt the material presented, which in turn lead to improvements in learning.

Given the success of interactive mLearning, we will continue to use *mInteract*, while at the same time working out better strategies to raise participation rates. Our study adds support to the existing research which shows that classroom interactivity using mobile devices is preferable to traditional interactive methods, such as a show of hands (Scornavacca, 2009). Given the increasingly widespread ownership of Internet-enabled mobile devices, it is logical to exploit their affordance for the interactivity required for transactional experiential learning.

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