LAMS and statistics pedagogy

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In this paper, we investigate the use of LAMS in two quite different classes in statistics, one at the first-year introductory level, the other at masters level, and show how it has contributed to the development of a learning community. We situate our investigation in a theoretical context to using such technologies in statistics pedagogy. We examine three specific learning activity sequences, examples from our two classes, and then look at students' reactions to their use and to the overall e-learning context. Finally, we reflect on our experiences and give suggestions for improvement.

Keywords: e-learning, Learning Activity Management System (LAMS), learning community, statistics learning

Introduction

We begin with an often-quoted statement from Ramsden (1992, p5): 'The aim of teaching is simple: it is to make student learning possible.' This viewpoint is less controversial nowadays than when it was first written, although ideas of teaching as transmission of information are still current, both implicitly and sometimes explicitly. But having accepted Ramsden's statement, there still remains an important problem: how do we go about making student learning possible? Essentially, a teacher puts together for their students a sequence of experiences that aims to bring about learning. This sequence of experiences should allow the students see the context of their learning and aim to broaden their view of the topic. According to Marton and Booth (1997, p79), it 'must address certain features of the learner's experience – a structure of relevance and a pattern of dimensions of variation – if it is to bring about certain qualities in their learning'. And the most important of these qualities is the development of new, broader ways of seeing and experiencing the topic. Laurillard (2002, p23) writes: 'Teaching is essentially a rhetorical activity, seeking to persuade students to change the way they experience the world through an understanding of the insights of others.'

An important aspect of teaching anything is to be aware of what students bring to the process – their conceptions of the topic and the discipline, and their ideas about the process of learning in that discipline. In the area of statistics, such investigations have been carried out by Reid and Petocz (2002a, b). With the narrowest conceptions, students see statistics as a series of techniques; with broader views students focus on making use of data – the artefacts of statistics; while with the broadest conception, students use statistics as a tool to make sense of the world and develop personal meanings. With the narrowest conceptions of learning in statistics, students are concerned with carrying out required tasks and accumulating techniques; with broader views students focus on applying statistical methods to learn about statistics itself or areas beyond statistics; and in the broadest conception students use statistical ideas to change their view of the world. Importantly, Reid and Petocz found the full range of conceptions in all the groups they studied, at first and final years, and statistics majors and 'service' students alike. We can thus expect a wide range of ideas about statistics and learning in any future class of students that we encounter, and we should take this into account when designing sequences of learning activities.

Of course, there is no general prescription for teaching everything, or even everything statistical, and the particular approach will depend on the specific situation and the specific topic of learning. Nevertheless, educational technology can provide some significant benefits as a medium for teaching and learning. Currently, larger numbers of students attend universities than ever before, with correspondingly higher student-staff ratios, and the student group is more diverse in age, nationality and linguistic background, and has more financial pressures to combine paid work and study. Information and communication technologies (ICTs) can enhance interactions between students, and even between students and staff, in a context where the participants are not present at the same time and place. This allows learners to benefit from the social dimension of learning, and to experience the relevance and diverse viewpoints that are necessary to enhance their individual learning. An online learning community, 'a group of people with a

shared purpose, good communication, and a climate with justice, discipline, caring, and occasions for celebration' (Boyer, 1995), can be created to replace or augment physical groups of learners. Kilpatrick et al (2003, p11) write that: 'Learning communities are made up of people who share a common purpose. They collaborate to draw on individual strengths, respect a variety of purposes and actively promote learning opportunities.' Any university class would benefit from such a sense of community, and its creation is surely one of the important aims of any lecturer. Many writers support this view and give practical suggestions for how to achieve such a learning community (see, for example, Smith and MacGregor, 2000; Klein, 2000) and particularly a virtual one (Anderson, 2004; Lewis & Allen, 2004).

In this paper, we examine the use of one such technology, LAMS (Learning Activity Management System, LAMS Foundation, 2006), as a component in a comprehensive e-learning strategy for addressing the pedagogical problems of two quite different units of study in statistics, one at the introductory undergraduate level, the other at the postgraduate level. We show that LAMS can include the full range of media forms, and can support the corresponding learning experiences, categorised by Laurillard (2002, p90) as narrative (attending and apprehending), interactive (investigating and exploring), communicative (discussing and debating), adaptive (experimenting and practicing) and productive (articulating and expressing). Using LAMS, together with other e-learning tools, a virtual learning community can be built, affording students opportunities for rich interactions amongst themselves and with their teacher, and allowing them to learn any time and at any place, and to engage with multiple representations of the object of their learning (Richardson & Swan, 2003).

Further, LAMS provides the particular benefit of allowing the sequence of learning experiences to be saved and shared with fellow teachers, either in a specific form (for instance, a sequence on introductory probability) or as a design template (for instance, a sequence built around the idea of reading an article, answering some questions about it, and then discussing the answers with the other members of the group to identify the one that seemed to be the best). This feature allows the academic community to support university teachers in their exposure to new pedagogic ideas and approaches. As Laurillard (2002, p222) points out: 'it is the natural task of any academic to do this in the context of research, but not teaching'.

Background

Our case study demonstrating the pedagogical use of LAMS is set in a large metropolitan university (Macquarie University) in Sydney, Australia, in the Division (Faculty) of Economic and Financial Studies (EFS). The Division has around 7000 full-time equivalent students and makes up about one-third of the University's total enrolment. Around half of the students come from other countries, predominantly from China, Hong Kong, Indonesia and Thailand. The Department of Statistics in EFS is one of the largest in Australia, with 24 full-time equivalent staff, and is responsible for a full range of statistics units from first-year undergraduate to masters courses. Two specific units form the context of our case study. STAT175 *Gambling, Sport and Medicine* is an elective first-year unit that introduces students to applications of probability and statistics in the areas mentioned. It is a unit without pre-requisites, and is not part of the main sequence of statistics units for students majoring in the discipline: class sizes vary from about 70 to 130 each semester, and the class in this study contained 77 students. MIST800 *Computer Applications in Business* is an elective postgraduate unit available to students studying a range of coursework masters degrees. The class consisted of 37 students, somewhat smaller than the typical class size of around 50.

As elective subjects, it might be assumed that students who enrol in these units have a special interest in the topics and would be more willing to attend lectures and participate in tutorials and laboratory classes. In other words, the students in the course would create a learning community out of their interest for the subject. While this is certainly true for some students, and more particularly for the postgraduate courses, other students select the units to fill gaps in their course, either in terms of timetabling, or in terms of university elective requirements, or in terms of replacing previously failed units. As lecturers, we are trying to build a learning community in each of our units (and also in the whole degree program). Such a community usually has an online component, making it convenient and flexible for learners who cannot attend classes or spend time with their peers after classes, and giving students who have not yet engaged with the unit a chance to participate.

In STAT175 *Gambling, Sport and Medicine*, around half of the students choose to attend classes (lectures, and laboratories/tutorials), while the other half choose to do the unit from a distance and never turn up to any of the formal classes. This is not an official option, although it seems to be a common strategy, possibly because all of the unit's materials are available on the unit website and because the unit is not a pre-requisite for any other unit. It can be most disconcerting as a lecturer to come to the first class and find only half of the enrolled students present, and furthermore to never even meet most of the others during the course of the semester! This pattern of attendance makes it very difficult to build up an inclusive learning community in the actual classes, and represents the most obvious pedagogical problem with STAT175 and the basic reason for including LAMS as a teaching and learning tool. Lucas and Meyer (2004, 2005) discuss ideas of student engagement with, and awareness of their subject matter, particularly in introductory courses, in a context where more students are studying in part-time mode, even when they are attempting a full academic load. In such a situation, academic study has to compete with work and social time for students' focus, and it is not surprising that it sometimes does not win in this competition. While some non-attending students in STAT175 seem to do very well, others achieve indifferent results or even fail.

MIST800 *Computer Applications in Business* comprises four topic-based 'blocks' that are usually taught by different lecturers. One block focuses on the notion of databases: this topic is addressed in lectures and tutorials are given one evening a week during weeks 4–6 of the semester, and an assignment is set during the last week of the block. Live interaction during these evenings is limited by the three-week time frame and by the fact that many students attend classes directly after a day's work, and hence are tired. Since the lecturer doesn't take any further classes, she finds it difficult to keep in touch with the students and help with discussion about the assignment or about the topic of databases in general. Those students who are proactive are able to communicate with her via e-mail or by visiting during consultation times, but such one-to-one interactions do not benefit other students. ICT tools become important in such a situation. The WebCT discussion or communication board can open up the interchanges to all interested students. However, building a learning community takes more than just discussions; learners need to share their experiences through solving problems together and then discussing strategies, solutions and conclusions. LAMS becomes a useful tool in such cases, giving an opportunity for further interactions between students that can take place asynchronously at any convenient time. The lecturer has created and used two LAMS sequences to give students the opportunity to develop and share their knowledge and views with each other.

Designs for learning experiences

In this section we will examine in detail three of the LAMS learning sequences that we have used in our units, two from STAT175 and one from MIST800. In this way, we will demonstrate the pedagogical approaches that we have trialled in response to the problems discussed in the previous section.

We start with a very simple sequence used early in the STAT175 classes (second or third week of lectures in the last section of the class) – the sequence is shown in Figure 1. The aims of the sequence are to begin the process of building a (physical and virtual) learning community, to introduce students to LAMS as a tool, and to illustrate ideas about gambling and randomness that are being discussed in lectures. We wish to help students link the theory with practice as physical or virtual gamblers, and to encourage students to formulate and test their own conceptions of randomness and to see the range of ideas that are present in the class: in other words, we want to show the 'structure of relevance' and the 'pattern of dimensions of variation', as Marton and Booth (1997) would put it.

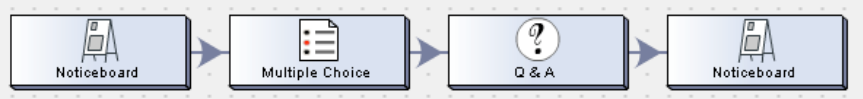

Figure 1: STAT175 'Coin tossing' sequence

The sequence is introduced by showing a short excerpt (the first five minutes or so) from the film *Rosencrantz and Guildenstern are Dead* (Stoppard, 1990): this is shown during a class rather than being inside the sequence for copyright reasons. The point of the film clip is the sequence of coin tosses that

each time come up 'heads', a total of 79 times by the end of the clip! The first LAMS 'noticeboard' summarises the film clip (particularly for students who weren't at the class). This is followed by three multiple choice questions: 'How likely are you to get 20 heads in a row when you are tossing a coin?' 'Why do you think Guildenstern checked the coin after 18 tosses?' 'Do you think that the sequence HHTHTTTTHHTHHHHHTTHT of 20 results is more likely than a sequence of 20 heads?' The alternatives encapsulate some common misconceptions about randomness, for instance, that a specific sequence containing around the same number of heads and tails is more likely than the specific sequence of the same length containing all heads. Students get feedback (including the correct answer) after attempting the three questions. Finally, the 'Q&A' tool is used to pose an open-ended question: 'In the film clip, they talk about 'examining their faith … at least in the law of probability'. What does the 'law of probability' say about coin tossing? Why do you think they got 79 heads in a row?' A final 'noticeboard' reminds students that they can come back and look at the answers from all the students in the class.

This LAMS sequence has a very simple design: an experience illustrating an unusual chance event, multiple choice questions with alternatives based on common misconceptions, and an open-ended question. No grouping is used within the sequence, so students can see the full range of their colleagues' answers. Finally, the results are displayed and discussed at the beginning of the following week's class, giving the lecturer an opportunity to discuss misconceptions about randomness, and the range of variation in students' responses to the open-ended question. Illustrating these misconceptions with students' own answers is a powerful way to show students the range of variation in their group. The sequence is left 'open' so that students who have not done the questions can try them later in the semester, and in fact many do take this opportunity, so that by the end of the semester most of the class have tried the sequence even though it plays no part in the assessment for the unit.

The second LAMS sequence is taken from the MIST800 class – it is shown in Figure 2. The sequence is used after the first lecture in which databases (Microsoft Access) are introduced. This introductory sequence has two aims. First, it enables the lecturer to find out what the students already know, in order to base the following lectures at a level appropriate for the majority of the students (Laurillard, 2002, p25) and hence build on their knowledge. Second, the sequence introduces students to LAMS and starts the process of creating a learning community by enabling discussions in an online environment. Students' comments (discussed later) show that the sequence is achieving this aim.

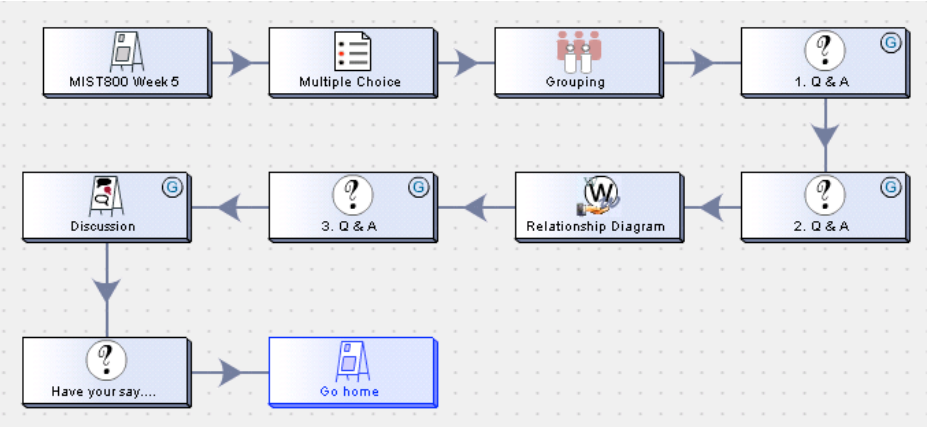

Figure 2: MIST800 'Introduction to Database' sequence

The sequence starts with a welcome message and then jumps into three multiple choice questions. These questions measure students' background knowledge about database concepts, for example: 'A relational database is organised as (a) a collection of records; (b) a collection of common fields; (c) elements; or (d) tables.' After completing the questions, students get immediate feedback – the correct answers are highlighted and extra information is given below the answers, for example: '(d) A relational database is organised as tables, where you can create relationships between them.' The 'grouping' tool puts students into groups of five before answering three open-ended questions. The first 'Q&A' asks students to 'explain the difference between data and information', a key distinction in the theory of databases. The second question is about the mechanics of relational databases: 'In a relational database, the order of the

columns is not important. Why not? Explain in your own words.' This has been discussed in the first lecture, but the lecturer has noticed in previous semesters that this is always a difficult concept for the students to understand. The third question is based on a 'relationship diagram' which students can see through the 'share resources' tool. After they have formulated an answer, the lecturer's answer is presented as a prompt for the following discussion which enables students to see the variation in each others' point of view in the light of a suggested answer. Then a 'have your say' asks them for comments on their experience of the LAMS online tutorial, and finally they are thanked for participating.

The majority of students in MIST800 are international, mostly from South East Asia from a learning culture that is quite different to the usual Australian (or Western) approach (Tweed & Lehman, 2002) – and these students are less likely to ask questions in class or participate in class discussions. LAMS allows an anonymity that seems to encourage all students to participate, irrespective of cultural or linguistic background, rather than being worried about not knowing the correct answer and possibly appearing foolish in front of their peers. An online tutorial such as this one gives students an opportunity to take time to think about questions and formulate an answer, and this may be beneficial to the students from non-English speaking backgrounds. The immediate feedback helps them to build their knowledge even if they didn't get the right answer originally, and the answers provided by other students display the structure of variation in ideas about the topic. Since the majority of students are working in a related area, the relevance of the topic is assured. Finally, answers to all the questions are discussed at the end of the next lecture, giving the lecturer an opportunity to review the points that students have misunderstood.

The third sequence, shown in Figure 3, comes again from the STAT175 classes, this time from an assignment on the medical section, towards the end of the unit. The aims of this sequence are to give students an opportunity to investigate a topic – the use of placebos in medicine – that goes beyond the topics that were explicitly discussed in classes, to encourage them to use their group to discuss and learn together, to practise writing and negotiation skills in an assessment context, and to consider ethical aspects of the medical statistics that they have been studying.

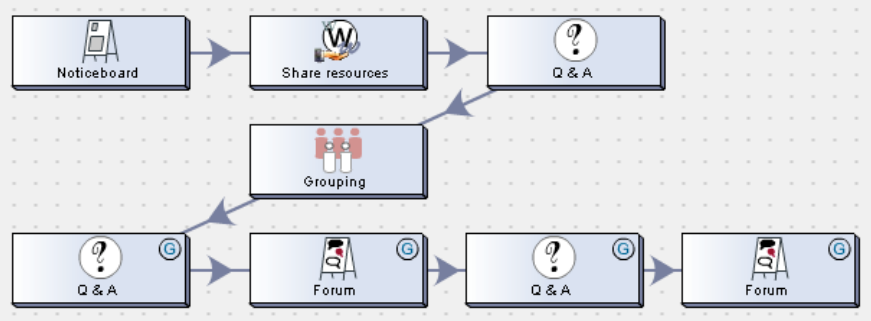

Figure 3: STAT175 'Placebo' sequence

The first 'noticeboard' tells students that they will be finding and reading a webpage that gives four experts' views on whether it is ethical to prescribe placebos, and then they will answer some questions about the article individually and in groups that are randomly put together by the computer. They are also warned that LAMS doesn't allow them to 'click through' the sequence and then come back later to write answers, so they are given previews of the three questions. The 'share resources' tool gives the web address of the article, and also directs them to an online dictionary: the first 'Q&A' asks them individually to define six words from the article (placebo, elucidate, therapeutic, chronic, hubris and paternalism), to help them with their reading (particularly those with other language backgrounds).

Students are then allocated to one of five groups (each large enough for a wide range of opinions). The second 'Q&A' asks: 'What is the placebo effect? Write a sentence in answer to this question.' The third question is: 'Do you think that the use of placebo treatments in medicine is ethical or unethical? Give some reasons for your answer.' Students respond to each question individually, and then move to the following 'forum' where they see the responses from all the members of their group. They are then asked to decide as a group which is the best response and why. As well as engaging with the relevance of the notion of a placebo in medicine, students are also exposed to variation in the views of experts (two of whom are in favour of placebos and two against their use) and in the views of their fellow students.

Negotiating the selection of the 'best response' from their group provides them with an opportunity of arguing for their point of view, or supporting others' ideas.

Students' (and lecturers') reactions

The use of LAMS described in this paper was a small-scale implementation in each of the two units. The main aim was to investigate the extent to which LAMS could be used to address the specific pedagogical problems in the units. As part of the investigation, students' views about LAMS were documented in several ways. In each unit, some sequences gave students the opportunity to make comments on the sequence itself, and on the overall reaction to the use of LAMS: around 20 students used this as a way of making their views known. At the end of the semester, five students attended a focus group to discuss the use of online learning in general and LAMS in particular in these units. Altogether, around one-fifth of the students enrolled in these two units contributed some comments about the use of LAMS: the 'silent majority' seem to have used LAMS easily and fluently, accepting it as one element in the range of online learning opportunities provided by Macquarie University for these units.

When asked to comment about LAMS, many students did not differentiate it from their overall e-learning experiences and pointed out the well-known advantages of online learning – the freedom to work whenever and wherever they wish, the immediate feedback, the opportunities for interaction with other students, and the alternative approach to learning that allows them to think about material from a different viewpoint (the words of all the quotes have been left as written by the students):

> The best part is that students can do this tutorial at any time and any place.
>
> Personally, I enjoy the part of multiple choices. I can confirm my knowledge by see the right answer after the test.
>
> It provides an answer immediately, that can help explaining the wrong answer immediately.
>
> It's good. Yeah, because it enables like interaction between students, teachers, yeah and as I said it's very easy to use, not difficult.
>
> The online practice gives us an alternative way to review the knowledge we learned in the lecture. I think this is a brand new experience to do it and I really appreciate it.
>
> I think it is very interesting and very good to process the online tutorial. I could learn in more detailed the theory and concepts about the database.

An aspect of LAMS that was particularly valued by many students was being able to compare their learning and understanding of the course material with that of other students in their class:

> It is very useful and it can help us to focus easily on the main point from the lecture material. It allows us also to have an idea on how others students are thinking and by this way evaluate each others understanding in the same subject. Thank you.
>
> This exercise was very useful as we can see other students answers as well.
>
> Thought it was useful to see what other people have written. It means that you are able to see if you are the right track.
>
> I think it is quite helpful because I can see answers from other people and if there is wrong answer I will know why it is wrong.
>
> I think it is useful: we can discuss and share the information.

> It is good, new method of doing online learning. Where we can share our answer and also we can discuss some topic while we are doing tutorial/lecture online.

Several students pointed out that they valued the face-to-face learning opportunities as well as the online ones, and implied that their preference was for a hybrid environment where the best features of each medium are utilised:

> In general I don't have any problem when doing the online tutorial. It is easy to follow and answer the questions. However, I cannot talk to classmates when I did that tutorial neither ask questions. To conduct, personally I prefer in class tutorial than online tutorial.

> The worst part is can't get enough help from the tutor in time. The best part is I can manage my own time.

> The worst part of the online tutorial is lack of interaction with tutor compared with traditional face-to-face tutorial. The best part of the online tutorial is the way of teaching is attractive to young students.

Some students were frustrated by being locked in to the particular sequence of activities in LAMS rather than being able to control the sequence of their learning (a point that was noticed and addressed in the third LAMS sequence illustrated above):

> This is online tutorial is pretty good. … But one thing should be mentioned is that students cannot skip steps that you want to choose and have to follow the step to seek your preferable part. It seems that the connection between every step should be set independently.

> Because I did not know how long is the class or what is the table of content, all the way I did the online tutorial, I felt uncomfortable. I would like to suggest that at the beginning of the tutorial, summary information on the class such as how long the class is and what is the table of content should be provided.

Finally, a quote from a student who joined the course late (and hence had missed the introduction in class) pointing to the ease of working with LAMS:

> I didn't get the background of it, I just did it at home. It was very informative and effective. As in, without background knowledge, I was, it was easily understood, professionally. The outlook was very fresh, very user friendly.

From our point of view as lecturers, the construction and use of LAMS sequences in these two units was very simple: each of us was able to prepare and use sequences with a minimum of effort and instruction. At the same time, we noticed that our materials were indeed increasing the engagement and the sense of learning community in our classes. The 'coin tossing' sequence was used in the STAT175 class as an introduction to LAMS, and although only about one-quarter of the class tried the sequence initially, when we used a second sequence (not illustrated here) as part of an assignment, many more students (a further half of the class) returned to complete the 'coin tossing' sequence. From our viewpoint, the interactions between students within the LAMS sequences illustrate a developing learning community: for example, the following comments were taken from the 'placebo' sequence:

> Group 5 - I think the definitions posted in our group are more or less have the same meaning. So for me, it is indifferent to have any of the answers chosen as the representatives of the group. But it is better to be written in one sentence. Do u guys agree?

> I think that [X] explained it in quite a good way too. it is quite true that the placebo effect is simply a positive change in a person's mind or body that resulted in a 'fake' drug. I also agree with [Y] in saying that it is a psychological benefit rather than a physiological effect.

Of course, the development of the classes as learning communities was fostered by a range of tools and pedagogical approaches, and we cannot claim that LAMS was the only successful one. Nevertheless, our view as teachers was that our use of LAMS sequences contributed to the overall working relationship of the classes and allowed us to guide the development of a learning community.

Further, in terms of the quality of learning in these classes, we believe that the LAMS sequences allowed our students to develop broader ways of seeing and experiencing the particular topics that they were investigating – the randomness in a sequence of events, the characteristics of databases and the notion of placebos in medicine. Moreover, we have specific learning materials that are ready for use in future classes, or for modification by ourselves or our colleagues.

Reflections and conclusion

Many university students are very familiar and comfortable with the range of technology that is available to support their learning. For them, the questions are concerned with which ICTs, with which features, might best support their learning. In a workshop on e-learning at Macquarie University in May 2005, four student representatives discussed their attitudes to the whole process of e-learning. All four of them stated that they preferred a blended or hybrid approach, rather than a complete online experience. Surprisingly, they stated that if e-learning was suddenly completely unavailable, what they would miss the most would be the availability of the learning materials posted on the web. They seemed very aware of the equity problems associated with differential access to computers and printers, but only one of them mentioned that online was a good place for student communication. Overall, they seemed to have a narrower view of e-learning than the full range of technological possibilities, possibly reflecting their experience, although of course there were only a small number of views and they were by no means randomly selected.

By contrast, the views of our students quoted earlier in this paper show a broader understanding of the possibilities of e-learning. We believe these may have been shaped by their specific experiences with LAMS, most particularly by the ability to see other students' responses and interact with them on that basis. In fact, the LAMS sequences illustrated in this paper each contain several aspects of the range of media forms and corresponding learning experiences identified by Laurillard (2002, p90). For instance, the 'placebo' sequence (Figure 3) is narrative (reading the article on the web site), interactive (exploring the definitions of the words in the online dictionary), communicative (the group discussion of answers and identification of the 'best' one), adaptive (changing participants' views in response to seeing the range of views from their group) and productive (the writing of the individual answers to the second and third questions). A sequence that did not contain all these elements could be extended to do so, and this might be an important use of this classification representing an improvement in the pedagogy. For example, with some modification the 'coin tossing' sequence could be narrative (if the film clip were included in the sequence, from a web site or an attached file), interactive (investigating the theory behind a sequence of coin tosses), communicative (discussing the answer to the final question online rather than at the following lecture), adaptive (by including a simulation of coin tossing to investigate the randomness of specific sequences) and productive (writing individual responses to the final question).

One point mentioned as important by experts in e-learning (eg Laurillard, 2002, p192) is that the locus of control of an e-learning activity should rest with the students. While LAMS certainly allows students control over the pace of their learning, it doesn't let them control the sequence of their experiences. The common desire to look ahead to see what is coming doesn't seem to be easy to manage in LAMS, and some students had the experience of 'clicking through' a sequence (with random keystrokes for answers), only to find that they could not come back and replace them with their considered answers. Of course, some aspects of a sequence are necessarily locked – we don't want students to have access to answers from other group members before they write their own answer. However, an ability to move forwards and backwards in a sequence may represent an improvement in learning opportunities in many cases.

Finally, we note that each sequence can be re-used either in exactly the same form (in later offerings of the same unit in following semesters – this has already been done with the 'coin tossing' sequence) or as a template in the same unit (for example, the 'placebo' sequence was based on an earlier sequence with the same structure investigating the notion of 'median') or by other lecturers in other units. In this way, the potential for the academic community to support teachers with new pedagogic ideas and approaches,

encapsulated in LAMS sequences or learning designs, is realised. In this way, the scholarly approach that we characteristically apply to academic research is also brought to bear on academic teaching and student learning. Bowden and Marton (1998, p278) discuss this nexus between research and learning, and conclude:

> The relationship between learning and research is to be found here in its most profound sense: through the most important form of learning learners develop new ways of seeing and through the most important forms of research new ways of seeing are introduced into our collective understanding of the world.

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