Showcasing Faculty Experiences with Technology Enhanced Teaching and Learning

SOM NAIDU AND DAVID CUNNINGTON

The University of Melbourne
Victoria, Australia
s.naidu@unimelb.edu.au
drc@unimelb.edu.au

This article describes a research project that seeks to explore the experiences of faculty with technology-enhanced teaching and learning. A particular focus of this investigation is on how the use of information and communications technology is influencing teaching practices and students' approaches to learning at the University of Melbourne. This is a naturalistic inquiry into the experience base of faculty who have been engaged in technology-enhanced teaching and learning. Our goal is to look beyond the existing, often rather superficial, data and closely examine how information and communications technology is influencing the nature of the teaching and learning transactions. We are interested in the "untold" stories of academics. These stories and reflections of academics are archived on the following website. See <http://dozer.infodiv.unimelb.edu.au/tales/tales.php>.

AIMS AND OUTCOMES

In the face of increasing use of information and communications technologies (ICT) in teaching and learning, there are growing calls for in-depth knowledge of *what* works, *why*, and in *what ways*? This article describes a

research project that is seeking answers to some of these questions from the perspective of faculty experiences. The goal of this study is to look beyond survey data and into the experiences of academics to capture their "untold" stories. We are hopeful that these stories would form the subject of further study and exploration.

CONTEXT AND SCOPE

The use of information and communications technologies are enabling campus-based providers to rethink and re-engineer the nature of their teaching and learning practices. The University of Melbourne, like many other educational institutions, is currently involved in just such a process as part of a strategy to position the University as a global player in higher education. As a direct result of this and along with the adoption of ICT, innovative approaches to teaching and learning such as problem-based learning and collaborative learning are being encouraged. These initiatives have led to the rise of new roles for teachers such as becoming "facilitators of learning" as opposed to being "deliverers of content" (de Verneil & Berge, 2000; Evensen & Hmelo, 2000; Salmon, 2000). They have also exposed students to new models and approaches to learning such as "computer supported collaborative learning" (Koschmann, 1996), and "computer supported problem-based learning" (Bernard, Rojo de Rubalcava, & St-Pierre, 2000; Crook, 1994; Dillenbourg, 1999; Koschmann, Kelson, Feltovich, & Barrows, 1996; O'Malley, 1995).

While interest is growing in the integration of information and communications technology in learning and teaching, a lot more needs to be known about how the use of ICT is changing teachers' approaches to teaching, and students' approaches to learning (Rumble, 2000). The need to investigate in some depth, how educational practice is changing with technology-enhanced teaching and learning is now imperative. This includes, among other things, understanding how approaches to teaching are being impacted, how teacher thinking about teaching and learning is being modified, how students' approaches to learning are changing, and how student support is changing with the use of ICT.

METHODOLOGY

The research described in this article comprises a naturalistic inquiry into the operating mode of educators. Naturalistic inquiry is particularly suited to questions such as these where the context is dependent on individual interpretations and perceptions (Lincoln & Guba, 1985). Such a contextual inquiry *demands* the active use of the inquirer's tacit knowledge combined with qualitative data gathering tools such as interviews, direct observations, self-reporting and think-aloud, and document analysis. The inquiry takes the form of successive iterations of these elements: purposive sampling, inductive analysis of the data, development of grounded theory based on the inductive analysis, and projection of next steps in a constantly emergent design (Lincoln & Guba, 1985; p. 187). Throughout the inquiry, and especially at the end, the data and interpretations are continuously checked with respondents, and differences of interpretation are negotiated until the outcomes are agreed upon or understood and reflected as such. This information is then used to develop a case report or profile.

DATA GATHERING

In this study, *interviews* are being used as the principal instrument for data gathering. The initial sample comprises academics who are seen as pioneers or leaders in the use of ICT in teaching and learning at The University of Melbourne. This sample will grow to include less experienced academics from the University of Melbourne and possibly others from other organizations including tertiary educational institutions, and commercial enterprises.

In the spirit of naturalistic inquiry, interviews are conducted on location. An interview protocol has been developed which sets out the goals of the interview and questions to guide the interview (Table 1).

Table 1

Initial Interview Protocol

Faculty Teaching and Learning Experiences with Educational Technology

What is our goal and focus?
- We are interested in ***your story*** and ***your experience***.
- These experiences will be presented in a database with a focus on the ***outcomes*** and ***impacts*** of whatever you and your students have done. It seeks to be ***reflective*** and ***conversational***, and will be available to all University of Melbourne staff.

So we would like you to reflect on your experience in terms of the following:

Planning
- Briefly describe the project.
- What were your goals and motivations?
- Why were they important, to whom and to what?
- What aspects of your teaching and learning you were trying to influence *(e.g., innovative approaches to content presentation, activation of learning, assessment, socialization, or provision of feedback)?*
- Describe your approach to learning and teaching in relation to this project?
- What was unique or innovative about this approach?
- What limitations of theoretical perspective did you encounter?
- What unique challenges did you face in planning your approach?
- How did you know if you were on the right track?

What you did
- How did you go about choosing the tools and technologies?
- What influenced your choice of these tools and technologies?
- What challenges did you face in selecting these tools and technology?
- What limitations did you experience; financial, technical or organizational?

What happened?
- Please describe the implementation?
- Any problems? What worked and didn't work?
- What monitoring processes did you put in place?
- How did you make use of the data that was gathered?

What you learned
- How did this innovation influence your view of teaching and learning?
- In what ways have you changed in the way you think about your teaching?
- How did it influence your students' approaches to studying and learning?
- Did it impact your understanding of your students' studying and learning?
- What are your successes, failures, serendipitous findings, lessons learned?
- What would you do differently next time?

Interviews routinely begin with a discussion of this interview protocol. This is to ensure that interviewees understand the questions, and are comfortable with their motives. With the permission of the interviewees, all interviews are audiotaped and subsequently transcribed. These transcripts comprise the raw data for the development of profiles of practice. The interview protocol follows the action research methodology.

DEVELOPMENT OF PROFILES OF PRACTICE

The interview transcripts comprise the raw data in this study. Researchers examine these transcripts to develop individual profiles of practice along the lines of the interview protocol. These are then presented to each interviewee to allow the filling of gaps in the profiles, verification of existing materials, and addition of any other thoughts on the matters raised during the interview. This in itself is an iterative process and might involve further interview and consultations with interviewees. The profiles are entered onto the database only when complete agreement has been reached between the interviewee and the researchers on the content of the profiles.

DEVELOPMENT OF THE DATABASE

Public access to this database is at <http://dozer.infodiv.unimelb.edu.au/tales/tales.php>. Data is entered using a simple web-based form to populate the fields (Table 2).

Table 2
Profiles of Practice Database Fields

Planning	Doing	Observing	Reflecting
Summary	Summary	Summary	Summary
Goals and motivations	Choice of tools	What worked	Impacts on your view of teaching and learning
Approach to learning	Influences on choice of tools	What did not work	Impacts on your student's approach to studying
Limitations of the approach Challenges	Challenges in selecting tools Limitations experienced	What criteria for success were used How those criteria were measured	What did you learn What you would do differently next time

Data is also included for standard project details such as the names and affiliations of faculty members, project leaders, date of implementation, and project type. Each profile also contains a brief summary of the project and current issues in the discipline. Where appropriate, data can be provided in formats other than text, such as images, audio files, or links to web sites.

The database is used to generate a showcase of academic practice. Users of the site can display full details of individual projects (Table 3) or customize the display of stories by focussing on a particular action research process, group of questions, or faculty. Display options include a choice of predefined categories, as well as browseable lists and individually constructed searches.

Predefined categories enable the display of projects by person, faculty, or department, as well as by each of the action research process. Search functions provide for customised views of the data that enable investigation based on specific interests. Keyword searching is also available across all fields of the database.

A FULL SAMPLE PROFILE

Table 3
A Complete Profile on the Database

Project: Understanding Bile Salts and Bilirubin Metabolism Faculty: Medicine, Dentistry and Health Sciences, The University of Melbourne **Summary of project** This project focuses on the study of the liver and hepatobiliary system in four modules, integrating basic and clinical sciences across disciplines, such as anatomy, physiology, biochemistry, histology, pathology, pharmacology, and microbiology. The educational content of this project matches with the philosophy of problem-based learning (PBL). The project is set up as a formative assessment exercise that enhances self-directed learning and the development of a wide range of domain specific cognitive skills. Students using the program are required to submit their answers to progress to the next task. If they are unable to provide an adequate answer to a question, they might use the "consult" button, which provides users with some guidance that enables them to rethink their perspective on the task they are undertaking. Feedback is provided to the users at different stages of each task in the four modules.

Table 3 (continued)
A Complete Profile on the Database

Current issues in the discipline
I think there are a number of challenges that are forcing us to introduce changes to our curriculum. In the traditional curriculum, teaching was often focused around single discipline areas. In this way the traditional approach created an artificial division between basic sciences and clinical practice. Although traditional teaching of medicine has served well for almost a century, it seems that the traditional approach was designed for a different society and a different time. Over the last 30 years, several aspects in our community have changed enormously and our understanding of the role of science and psychosocial issues in relation to health and illness has raised the need for a rethinking of medical education strategies. Several problems were encountered during the implementation of traditional curricula. For example, the application of knowledge acquired from basic sciences can be difficult and the acquisition and long-term retention of information that has no apparent relevance can be boring and of limited value.

Planning—Summary
As I was planning for the project with a number of goals in mind I thought that I would never be able to achieve these goals unless the project was designed in an innovative way that kept students engaged and motivated. I did not want to repeat what is already mentioned in text books or lectures and I did not want to encourage rote learning but rather, use and application of knowledge, interpretation of data and clinical findings, decision making strategies and deeper understanding of the scientific basis of mechanisms and underlying pathophysiological processes. These important educational issues have no place in textbooks or lectures. In this project, I have created a broad range of learning and formative assessment tools that reflect these educational needs. I think I would not have been able to achieve these goals without the use of the technology, for example, the creation of a three dimensional model of the liver by the user, where students can clearly observe the complexity of the organ, the blood and bile flow and function of the different transporters (carrier proteins) which have been recently cloned. Deep understanding of these principles would not have been possible without the use of multimedia. The template, which encompasses the clinical cases, has been developed with these goals in mind and comprises an example of the effective use of technology in medical education.

Planning—Goals and motivations
The main goals of this project are to help students identify boundaries of their learning; enable them to test their understanding of concepts and principles raised in the course; allow them to use and apply information learned; and provide them with detailed feedback to help them deepen their understanding of the issues. We have been encountering many problems with this conventional approach. The new approach: (1) reduces dependence on factual knowledge; (2) enhances self-directed learning and communication skills of the students; (3) encourages integration of basic and clinical sciences; (4) introduces community-related issues and small group learning; and (5) introduces changes to assessment to match with the philosophy of the curriculum. This approach emphasizes the need for formative assessment strategies, which this project addresses.

Table 3 (continued)
A Complete Profile on the Database

Planning—Approach to learning

I think there are several unique components of this project. When I thought about planning this CD-ROM, I had a number of educational objectives. I wanted to enhance students' cognitive skill. This is achieved through the clinical cases. We asked students, for example, to identify the problem(s) in the triggers they are presented with. Then we asked them what could possibly be the causes for each of these problems? We thought that if we tried to build any project for formative assessment it should match the design and structure of the curriculum. I contributed to the writing of PBL cases used in the curriculum in Semesters 1 to 5, the first two years and a half, and this gave me the opportunity to see the overall curriculum and also identify areas of deficiency or areas that needed support and supplementation. In every phase of this program, a question provokes thought. We have an activity and then the "think" question that leads students to think ahead about what is going on. As the program progresses they might say, "Oh wow, now I understand that question." Therefore, I give them challenges and motivation to think about what is going on. Whether students finally comprehend the question after one page or three pages does not matter. I also have a number of multiple-choice type questions at the end. I am also going to provide scenario-based MCQs at the end of each module, which will assess application of knowledge.

Planning—Challenges

It has been claimed, "assessment of cognitive skills of students is not only the most difficult but also the most neglected area in the assessment of medical students." Formative assessment involves using assessment information to provide feedback into the teaching/learning process. These two statements reflect one of the major challenges that students and course planners usually face in a PBL curriculum. Students in a PBL course usually ask, "Am I doing enough? How do I know if I am doing enough?" In this project I am trying to create an innovative, formative assessment tool that motivates our students and keeps them engaged using a PBL approach. My aim is to transform learning into an enjoyable experience that suits students' needs and keeps them engaged in the different educational challenges in the project. The aim is not to solve the problem but to drive the use of basic sciences in a clinical format and enhance self-directed learning in an integrated way.

Doing—Summary

In the new medical curriculum, our students learn by using PBL cases on a weekly basis. Every case is discussed in two tutorials, each of which is two hours long. Discussion of these cases is carried out in small groups of 10 students and the tutor of the group helps in facilitating the discussion. In my project, the educational philosophy of PBL has been maintained but one user rather than a group will complete the tasks. Students who used the program last year and contributed to a pilot study commented that they found it useful. They also commented that, "the PBL cases were useful to my learning and understanding of basic sciences related to the case. It reflects what I really need…the interactive learning and the feedback after each task has increased my learning and kept me engaged in completing the

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Table 3 (continued)

A Complete Profile on the Database

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module. I did not realize how much time I spent on it. However, it was really a great experience I thought the PBL cases reflect what we need for the summative assessment. There are no resources for us that we could use. This program is useful and kept me learning."

Doing—Choice of tools
What we decided upon is a CD-ROM designed for Mac and PC users. It took me about four to six months to design a template for the clinical cases and ensure that each part reflects specific educational objectives. The template allows students to type their answers in and submit them before proceeding to the next task. They can use the "consult" button, if they feel that they are unable to provide an adequate answer. They can also refine their hypotheses and their mechanisms on the basis of the new information available to them as they progress in studying a case. In all the four modules of the project, the use of technology was a means to comprehend deep learning rather than my main objective. My main goal was to ensure integration of basic and clinical sciences in an accessible, motivating, and challenging format that ensures deeper level learning.

Doing—Challenges in selecting tools
I wanted to come up with an effective tool that reflects the educational objectives of the project and could be used in formative assessment. However, turning the contents of the project into interactive tasks was not simple and required a lot of thinking, testing, and investigating the best tools that could clearly reflect the project's objectives. The biggest challenge was the need to prepare all the drawings and the diagrams in the project, as our graphic designers were not trained to draw scientific diagrams and anatomical animations at the level of accuracy I needed. We had to ask them to repeat what they produced to reach the level of accuracy needed. It is fortunate that I have the skills to design and prepare these drawings but this required me to work hard during several weekends, to complete the drawings and type the content needed. Clinicians in general and many academics are always busy and they see what you might ask them to do as a service in which they do not have to put any commitment or effort. In the end I usually have to research the topic, collect the needed information, plan the interactivity or animation, write the contents and prepare the drawings. A third limitation was the limited resources and the need to use the project budget effectively. This at times forced me to limit some of the interactive exercises I wanted to introduce in the project.

Doing—Limitations experienced
We have been faced with three main challenges. The first challenge has been how to manage our budget and effectively use the project grant to create an integrated program that reflects the educational goals outlined in the application whilst keeping students engaged. The second challenge has been how to create a project that suits the needs of all students, both the graduate-entry students and year-12 school leavers. The third challenge has been how to maintain motivation and creativity in the four modules and ensure that there is a good flow of the material

Table 3 (continued)
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presented, integration of basic and clinical sciences and unity across the whole project. Although I have a strong background in this area, it is worthy to note that the creation of this project has been very demanding. The project manager has helped me a lot in this aspect, particularly in the early phases after we received the project grant. It was difficult to keep up with our plans because of other urgent tasks.

Observing—Summary
There are four modules in this set of exercises, and each module has specific objectives. The first module starts with clinical cases and is very interactive. It opens with a trigger text and the students try to find out what the problem is and then they can type in and submit their answers. If they don't know the answer they can click on the "consult" button, which will provide them with more open-ended questions that try to make them rethink exploring the original questions in a proper and systematic way. We do not give them the answer—we give them a prompt. This encourages them to think and then use the question to comprehend the original question. In medicine there are many times when you deal with uncertainty. You might get a patient in a coma and you have no information about his or her condition. We need to prepare our students with strategies that enable them to deal with such uncertainty. The second module is about understanding the structure and the function of the liver in an integrated way. The third module is about bilirubin and liver function test. Bilirubin is a substance produced as a result of breakdown of red blood cells and the release of haemoglobin. Bilirubin is metabolized in the liver and if it is present in the blood in high levels it causes jaundice. It is an important issue for medical students to know about. Then we have the bile salts and the enterohepatic circulation in the last module. The clinical cases together with an understanding of the basic sciences and putting them together in one project like this, gives students the opportunity to study different disciplines about the liver in an integrated way, which is very similar to the philosophy of our curriculum. On the one hand, it complements the curriculum and on the other, it gives students a hands-on approach of thinking about these issues.

Observing—What did and did not work
Yesterday, I was running the project in the computer labs with a group of students. I was impressed with the level of the discussion and the way they looked at information and integrated it with related pieces of information from other disciplines. We were discussing the different zones of the liver and how the liver cells (hepatocytes) in each zone has specific functions. It was good to see how students were able to make the link between the locations of the cells, the presence of high oxygen concentration, as it is the case with cells in zone 1, and the presence of a large number of mitochondria in these cells. I was very pleased with their approach and how they learned by discovering, integrating information, and expecting changes or outcomes. Obviously, the program was working very well. I stayed with the students from 2:15pm until 5:15pm and they were coming in and going out. However, I think some of them spent the whole three hours working with it, they did not move. They were very engaged and the way they asked the questions

Table 3 (continued)
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was fantastic because it made me think hard. It was very good feedback for me. But it also gave me an opportunity to think about areas where, for example, there is a little jump that needs a screen inserted to facilitate an area and prevent them from asking these questions. But you can also see graduate students are not asking questions. Some of them have a PhD, some of them have a Masters Degree. So even when I ask them, "How do you feel about the project? Do you need any help?" They say, No. This is fantastic. Some of them cover most of it in a short time, while others do struggle sometimes with a difficult words etc.

Observing—What criteria for success were used
Last year we ran a pilot study to evaluate the project. The students' feedback on the project was tremendously positive and encouraging. I felt motivated to put more effort into it and keep working on the interactive tasks, the MCQs with feedback on each item and the clinical cases. These three areas were rated very highly by students who also commented that it was useful to their learning that the cases in the project were designed in a way that matches with the PBL philosophy. There were no educational or technical criticisms from students except that some students commented that it would be much better if they could print out or download their answers to the clinical cases. Our team is currently reviewing this issue.

Observing—How those criteria were measured
I think evaluation is a very important thing. Last year I had a meeting with Gregor and this year with Mike Keppell, to design the questionnaire we will use in evaluation. Our survey comprises questions on the aims of every module, the design used, the animation and diagrams, flexibility, the flow of the content students' understanding of the material. I also have a pretest and posttest to see whether students are using the program effectively for that amount of information. Students and staff also give me feedback on the project in person. They can go to one of the PBL rooms, work on the CD-ROM and then come for an interview. I might be there interviewing some students and also using the evaluation form, and comparing any differences in the responses between the Australian universities—Sydney, Queensland, Western Australia, and Flinders University.

Reflecting—Summary
I did not expect that some of the students would finish a module and do the second one in such a short time. I was expecting that it would take them much longer to do that. I was surprised when I saw some of them had finished the first and were moving into the second module and saying that tomorrow they will be doing the next module. They had done it well too. I think that our students are very able. We need to think about teaching and learning with new perspectives. I think if we present things differently and change the way we teach, we could succeed in keeping these students engaged. Learning should be fun as well. We need to introduce innovative ways in the design and delivery of the curriculum. We need to use new ways to motivate our students to learn and search for new information. I

Table 3 (continued)
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think these issues are important components in the design of this project. I learned that designing computer-aided learning programs, although very demanding and challenging, was a great learning experience. I enjoyed every aspect of it.

Reflecting—Impact on your view of teaching and learning
I think one of the things that I learned is that you need to listen to the students because the students are best placed to give you feedback. I think students, because they have no background in the area discussed, have views, which usually reflect their needs. However, when I ask a consultant he or she usually focuses on the scientific content rather than student perceptions and better ways for facilitation and presentation of information. One of the things I would like to say in this regard is when I write a PBL case I usually go to one of our PBL rooms and spend some time on the case reviewing it from a student's point of view. I think this is important in the development of the content of the project. It is important to be innovative and creative in what you present. Socrates once said, "A teacher is a midwife to a student pregnant with ideas." This is exactly what we mean by facilitation. I think teachers need to move away from spoon-feeding students with information. You cannot feed them with every piece of information. The huge explosion of information will not allow you to do this. Instead, we need to encourage self-directed learning and help students use and apply information in different situations. We need to challenge our students to move away from rote learning. I think we need to introduce innovative learning and assessment strategies that enhance their cognitive skills development. We also need to evaluate the value of such computer-aided learning programs in enhancing student learning. I think it is very important to teach people in a way in which they do not feel offended. The rule we have is nobody can teach problem-based learning until they complete the required training workshops, so that we ensure consistency in the delivery of the curriculum and that the method used in the tutorial is facilitation rather than traditional teaching.

Reflecting—Impact on your student's studying and learning
Around 50 students used the program in Semester 2 of Year 1. Usually they use it during weeks nine, ten and eleven. They will also use it in Semester 5, in the third year of the course. Most students use it between lectures, during their free time. I think students in our PBL course are trained to think, to deal with uncertainty, to apply information, to identify their learning needs, to learn in small groups in a collaborative way and ask good questions. They are different in this regard from the students we used to teach in the traditional curriculum. I think in the traditional curriculum students focused on learning pieces of information while now their aim is better use of information and reflecting on what they are learning, exactly what we want them to be able to do.

Reflecting—What you learned
In this new approach to teaching and learning students are challenged to think, and we should continue to challenge them and enhance their abilities to link information, look for supportive evidence, make decisions and try to use information in solving problems. I think that this way of teaching is much better. Even when they go to

Table 3 (continued)

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search for their "learning issues" they will not go and read a chapter in a textbook, but rather search for answers to questions they have already identified in Tutorial 1 of each week. It is interesting to see that they use a wide range of resources as they prepare for the second tutorial. Students in the new curriculum are using the library in an efficient way. It is not any more "just a quite place for me to study between lectures," it has become a place for enhancing self-directed learning.

Reflecting—What you would do differently next time
I think there are a number of developments I would have liked to include in my program. One of these is to enable students to review the answers provided by other students and learn not just through the feedback provided in the program but also through peer learning. We will need to find a grant to support us to carry out this addition. The other thing, which I am after in the future, is the reuse of the templates of the clinical cases, which we have created in new projects. It took me about six months to design the template and it took the graphic designer about two months to complete it. So we should be able to ruse it in other projects.

CONCLUDING REMARKS

The work that is described and discussed in this article grew out of a growing call for "evidence of the impacts" of ICT in teaching and learning in the tertiary sector. While this is a question that has been asked many times, answers to it have not been conclusive. There is a lot of evidence to suggest that the use of ICT in tertiary teaching and learning has many advantages. There are also suggestions that these benefits do not justify the cost, time, and effort that this kind of work entails. Many of these findings are, however, problematic as they are based on neither reliable nor valid research techniques. The work that is reported in this article incorporates investigation techniques that depart from the commonly used approaches to the quantification of user perceptions with questionnaires and surveys of sorts.

Our goal in this work is to capture the experiences of academics with the use of a range of data gathering techniques that are grounded in the principles of naturalist inquiry. We realize that data derived from these kinds of approaches are not easily "generalizable" to other contexts. However, we expect that over time, we will have in this gallery the amount of information and data that is necessary to draw conclusions and make meaningful generalizations. We anticipate that this gallery will grow into an extremely rich resource of the experience base of not only many of our pioneering efforts but some of the most innovative work that is being undertaken in this

regard at the University of Melbourne and elsewhere. A larger collection of profiles in the database would enable the examination of models of behavior among academics that could become the subject of further study. Questions that might seem relevant would include: what are the reasons for particular approaches to teaching, and what are the prominent approaches to student study behavior? We hope that further exploration of these questions will help explain how the use of technology is influencing teaching and learning transactions.

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