

Physics teacher retraining through flexible delivery

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Introduction

The Graduate Certificate of Physics (GCP) described in this paper is a response to two recent educational phenomena. The first is the escalating shortage of teachers in the physical sciences, and the second is the rapid development of increasingly sophisticated platforms for online delivery. A particular requirement of this retraining course was the capacity to cater for science teachers in rural areas of NSW, where secondary schools had a need for trained physics teachers. Distance education has, traditionally, been used to fulfill the needs of isolated students but has been regarded as a less desirable and more expensive alternative to more traditional models. The advent of computer-based learning has led to the possibility that flexible delivery modes may become as effective as traditional, on campus courses. In a recent review of the effectiveness of online education Jung and Rha (2000) suggest that reduced costs and increased revenue have been major factors in the drive towards online education, but many studies purport to show that online delivery modes produce educational outcomes that are generally as effective as more traditional face-to-face modes. Some observations (Inglis 1999) suggest that online education may produce improved educational outcomes through wider access to a variety of multimedia resources and information combined, surprisingly, with increased opportunities for interaction with other students and instructors.

It has often been assumed that missing out on traditional experiences such as lectures compromises the quality of the learning by distance experience. Biggs (1999; p.113) describes how, at the institution where he taught, parity between internal and external students was maintained by denying the internal students access to the external lecture notes, to make up for the advantage the internal students had in being able to attend the on-campus lectures. In fact, numerous studies suggest that distance education often seems to be as effective and sometimes more effective than traditional modes (Jung and Rha 2000). Some recent studies of courses that have been delivered online suggest a high level of acceptance by students (Chang and Fisher 1999; McConnell and Shoenfeld-Tachner 2002). The latter study involved a science course (in histology) in the USA. Students in this course judged it to be 'readily accessible and at least equal in academic rigour to comparable on-campus courses.' One of the main issues in the development of the course described in that paper was the incorporation of appropriate laboratory work. Our belief that a substantial laboratory-based experience was needed was the main reason for incorporating a residential component into the GCP. This paper explores the tension between flexible/distance teaching modes of delivery and the more traditional teaching and learning environments provided during the residential component of this course.

Course structure and challenges for delivering physics flexibly

This GCP was designed to provide existing science teachers with an appropriate qualification to teach senior (Year 11 and 12) physics in NSW government schools. Students are all qualified secondary science teachers and most are teaching full-time during their study. More than half the students are from rural schools. The course provides a Graduate Certificate of Physics, comprised of two physics subjects, comparable to first year university physics, and one subject dealing with pedagogy and assessment in physics. The course is being delivered over two semesters and combines

three delivery modes: a web site using the *WebCT* interactive teaching platform, a physics textbook (Giancoli 1998) and two week-long intensive residential. The *WebCT* sites have their own secure internal mail systems, which allows private student/student and staff/student communication.

Concern has been expressed with respect to the capacity of flexible delivery to cater for some types of learning outcomes in higher education settings. Toohey (1999; p.118-120) suggests that the delivery of technical and conventional knowledge through flexible delivery modes is fairly unproblematic, but that deeper understanding of complex concepts that often run counter to what is learned from common experience provides some challenges. The solutions she suggests tend to emphasise the need for quality interactions, usually between ‘tutor’ and students. An important development in available platforms for delivering courses online is in their capacity for interactions, both student/student and student/teacher. *WebCT* provides bulletin boards that allow asynchronous communications throughout the semester. It also allows the lecturer to track and monitor these interactions. It would appear that we are fast reaching the stage where this facility is providing access comparable to that provided through traditional courses. In a review of a wide selection of courses provided flexibly, Beattie and James (1997) found that some staff felt that the level of interaction was better than usual and that the gap between lecturer and student was actually reduced. Several students reported that they had a more ‘human’ relationship with their lecturers. Questions were still raised by students, however, about the quality of feedback in terms of their learning and understanding.

There is evidence that the types of interactions that occur through online discussion groups and bulletin boards are different to the types of interactions that occur in normal tutorials. Hewson and Hughes (1999) ‘were surprised by the slow-motion nature of the classroom dynamics of our online group’. Contributions to the bulletin boards tended to be more formal and less spontaneous than in live groups, and pauses that could normally last a few moments could last for days online. Our observations in other courses delivered through lectures and tutorials but supported by a website with bulletin boards reinforce these observations overall. Interestingly, we have found that the types of issues raised on the bulletin boards can be quite different to those raised in live tutorials, as if the distance and disconnectedness of the online environment allow students to broach issues they would hesitate to raise in class, perhaps because they are not related to the current topic of discussion or because the students would be embarrassed to raise them.

How well has the flexible delivery worked?

This course was regarded as a success both in terms of evaluations carried out by the University of Canberra and the NSW Department of Education and Training. Students were provided with the opportunity to evaluate the course through an anonymous online questionnaire at the end of each semester. This is a standard feature of the *WebCT* platform. A specific question asked was, ‘Now that you have experienced the full range of modes involved in this course, could you estimate the relative importance of each mode in your learning of physics and physics teaching?’

Out of 25 students who attended the residential 20 responded to each evaluation. The students valued the residential significantly above the other two modes (Figure 1). The final bar on the graph shows the combined response to the textbook and the web site given that these two were designed to complement each other.

Nevertheless, it is evident that students valued their time at the residential very highly. It was also evident that the lecturers valued the residential no less. Classes and workshops were scheduled daily from 9:00 until 6:00 and effectively involved most of the lecturers teaching beyond their prescribed load to achieve this. This suggested some urgency on our part to extract all possible value from this component. It is notable that the students, in the rest of their evaluation, provided very positive feedback on nearly every session despite the excessive workload. For a range of questions about

various aspects of the first residential the average Lickert scale score was 2.1, where 1 represented 'excellent' and 5 represented 'unsatisfactory'.

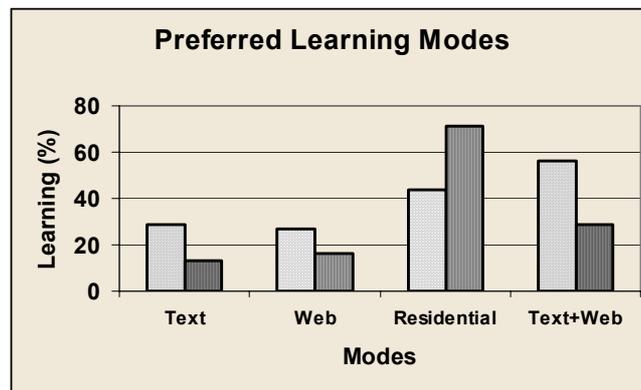


Figure 1. Student perceptions of how much each component of the course contributed to their learning from the mid-course (light) and final (dark) evaluations [N=20]

Biggs (1999; p.115) has suggested that although students (and teachers) can overcome their initial fear of electronic technologies 'they and their teachers still feel the need for face-to-face contact'. In a recent address at the UniServe Science Annual Conference at the University of Sydney (April, 2002) Beryl Hesketh spoke of the danger of 'cigarette courses', where trainers and students happily agree on, and become addicted to, enjoyable but less than exemplary teaching and learning strategies (Hesketh 2002). In our course it is difficult to resist the conclusion that there was some collusion between teaching staff and students in honouring and valuing the face-to-face component of the course.

In the final evaluation the residential was valued even more highly, up from 44% to 71%, as the preferred mode of delivery and combined usage of the text and web-based modes was reduced from 56% to 29% (Figure 1). The increased value of the residential to students may, in part, reflect the incorporation of two assessment items within the residential period. It also corresponded with a drop in usage of the discussion page and increase in the usage of the email tool to interact with the course manager. This behaviour reflected a greater familiarity with the *WebCT* site and hence more selective use of the tools therein, and coincided with a general ramping up of teaching responsibilities toward the end of the school year. The apparent change in the students' study patterns from curious exploration of the *WebCT* site, and greater experimentation with tools early in the year to more assessment-driven use of the tools toward the end of the year is interpreted as a manifestation of time pressures felt by participants. There is no doubt that this was still valued as a central part of the multi-mode delivery... 'I love the *WebCT*, it freed me from being a slave to date/time and allowed me to work at my own pace'

Correspondingly, focused use of the text and Web combination based around prescribed readings has resulted in decreased valuing of this component in the evaluation, even though the core of their learning was still derived from these complementary delivery modes. Because the residential allows dedicated time-on-task it provided a focus for endeavour in second semester, even more than it had in first semester.

In response to a question asking whether the course improved their pedagogic knowledge there was a normal distribution in responses. Typically the participants felt that they were already experienced teachers, so they were sometimes sensitive when the course touched on issues relating to their teaching and pedagogy. For this reason staff needed to be diplomatic in their interactions with students. Likewise, when asked about whether this course would assist with their teaching in other discipline areas their response was neutral. This could, understandably, reflect their perceived mastery of their own discipline area, but illustrates their initial failure to recognise the relevance of

physics concepts to their area of specialisation. Nevertheless, they responded more positively that the course had refreshed their enthusiasm for teaching. In addition it had led to an improvement in their presentation skills even though most had had many years teaching experience.

During this course the 25 students sent more than 1500 emails and the efficient response to these was appreciated and acknowledged by students in the evaluation. An important aspect of the course was the level of pastoral care, which the NSW Department of Education and Training valued highly. *WebCT* provided a platform where students had easy access to each other and to lecturers in the course. We would agree with Beattie and James (1997) that, in this case, online learning involved a higher level of contact than would be typical in a traditional face-to-face course. Students responded very favourably to all evaluation questions relating to pastoral care. Within the *WebCT* site the tools they valued most highly were the email and Discussion Page, which facilitated interaction with staff and peers. The synchronous Chat tool was not utilised because students found it difficult to coordinate timetables. Another weakness of the site is the fact that URL links introduced as part of the e-text facility cannot be updated readily and progressively drop out. In a high-pressure course of this type, students are not tolerant of this and were critical in the evaluation. A mechanism for updating linked electronic texts, in a timely fashion, is essential for their effective use.

It would be expected that studying in an online environment would lead to an improvement in Information and Communication Technology (ICT) skills. Although the students reported only some improvement in this area it is our impression that, by the end of the course, the students were incorporating ICT into their teaching significantly more than they were at the beginning of the course. As previously observed, they were also using the *WebCT* site more efficiently by the end of the course. An unplanned strength of the course is its appeal to female teachers (56% in 2002, 65% in 2003) in a discipline area traditionally dominated by men. The flexible delivery allows these students to fit their studies around their home and work responsibilities. Positive feedback from individuals since the course has finished includes advice that at least two participants used their Physics qualification to assist with promotion, and several others were assured of permanent positions as a result of their retraining. Others described innovative teaching and learning tasks that they had designed and implemented since completing the program.

Impressions of staff and students

The students in this course have expressed opinions in a variety of forums. As well as providing comments formally through the online evaluation they have commented through the bulletin boards as well as in person at the residential. Given the recognised importance of effective interactions in quality learning it was interesting to observe the nature of the interactions as they developed during the first semester of the course. Very few of the students had met before the course. At the commencement of the course most of the students visited the campus for one day of orientation. This seems to have been significant in the development of student/student interactions online. Of particular interest was the development of a relationship between the students and the lecturer who managed the web site (LM). Despite the fact that they had least interactions with her at the orientation, by the time of the residential, two months into the course, they had developed a particular trust in her. This became evident as students approached her rather than the other lecturers about their concerns. In this case a definite relationship had developed through online interactions. This supports the observations of Beattie and James (1997) that some staff have experienced improved contact with students in online courses. At the residential more than one student asked if that lecturer was going to be at all the sessions, despite the fact that this was not a part of the course that she was particularly involved in. There was a definite feeling among staff and students that the residential would represent a significant step forward in the course overall in terms of student understanding of topics and concepts. The lecturers took comfort in having the students in front of them and both staff and students seemed relieved at having the capacity for real-time interactions. Both staff and

students were in agreement that as many difficult theoretical topics as possible should be covered while we had the chance.

According to the written responses of the students in the evaluation it would seem that:

- in general students appreciated the opportunity for direct contact;
- students were keen to cover as much material as possible during the residential;
- students were seeking even more experiences of practical work;
- students were prepared to put in long hours to achieve the above;
- students tended to expect material directly focused on NSW syllabus to be covered;
- students were concerned with how the physics concepts would be related to the classroom;
- students sought material on contexts and applications, beyond what was in the book; and
- students showed many signs of being ‘deep learners’, in terms of their diligence, engagement and perseverance, but their perception of depth did not necessarily extend to topics outside their own syllabus or with issues of a general pedagogic nature.

We would conclude that the residential, which provided a close approximation to a traditional learning environment, was accepted by both teaching staff and students as providing essential components of the course beyond the laboratory and practical work. These included a range of material relating to both theoretical knowledge in physics and applications of physics.

Conclusions

One of the major issues raised in this paper is the tension between flexible delivery and traditional models of tertiary education. Both students and lecturing staff in this course have been drawn to some aspects of face-to-face delivery. This has occurred in the area of laboratory work, which is not unexpected, but also in dealing with a range of more complex concepts and applications. Other studies have suggested that these are the areas where traditional, on campus teaching may be preferable, either because of the need for specialized equipment or because of the need for effective interactions.

There are a number of possible motivations for instigating a flexible delivery approach.

1. *Students are isolated.* This was the case for more than half of the students in this course.
2. *Students are busy* and prefer a more convenient approach. A third of our students came from the Sydney metropolitan area yet chose a distance course based in Canberra rather than a local alternative.
3. *The flexible delivery modes may be perceived to provide better learning experiences than traditional modes.* This was not the motivation for development of this course.
4. *Flexible delivery is perceived to be easier or cheaper to deliver.* In its first year this course has been staffed at a rate 30-40% above normal. It is anticipated that as a continuing course it would continue to be staffed at 10-15% above normal. It is, therefore, considerably more expensive than traditional courses.

The main reasons for this course being delivered flexibly relate to the first two points. The isolation of most of our students makes traditional delivery impossible. The convenience factor is also important. But this raises another issue. Tertiary educators are becoming increasingly aware that their students have little time to devote to their studies. Even in undergraduate courses students are likely to work long hours in addition to their studies. Flexibly delivered courses tend to cater for students who are working full time, in this case as secondary teachers. This is likely to have a far greater effect on the success of their studies than the mode of delivery. It also means that the deliverers of such courses tend to make allowances for the limited time students have available for study. We would make two observations based on our experience in this course. Firstly, face-to-face delivery modes have a number of qualities that cannot be replicated in any distance mode, even with the power of modern web-based platforms. But second, we recognise that online delivery can add



dimensions that complement traditional delivery modes. Perhaps in the future many more courses will combine modes in this way, utilising the best elements of each.

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