Evaluating
On-Line Technology
To Support Students Studying
Engineering Management
in Summer Semester

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Introduction

An undergraduate engineering management unit was offered over summer semester in a time-shortened, off-campus mode only for the first time. To support students, an on-line unit site was created. An evaluation exercise was undertaken to assess the effectiveness of this arrangement, to identify what types of on-line resources students rated as important, and to identify those on-line resources that students actually used in their summer semester studies. The exercise and results obtained are presented in this paper.

A Summer Semester Unit
in Engineering Management

The School of Engineering and Technology at Deakin University offers a three-year Bachelor of Technology and a four-year Bachelor of Engineering at the undergraduate level. The programs are delivered on-campus, full-time for conventional entry students who come directly from secondary school. Mature-age students may study the programs off-campus and/or part-time. The use of computers is an integral part of

all the engineering study programs. The programs are based on a model of flexible delivery systems that incorporates:

w a modular curriculum;

w a formal assessment system for recognition of prior learning (both academic and experiential) based on granting advanced standing in appropriate course modules;

w course modules developed in print form, supplemented by an array of learning resources, including audio and video presentations, home experimental kits, computer-aided learning packages, remote (Internet-based) laboratory experiments and conventional laboratory work requirements; and

w computer-mediated communication systems, including e-mail, video conferencing, WWW-based bulletin boards and Internet-based conferencing.

The level three (nominally third year) unit SEB311: Methods of Managerial Decision Making covers project management, operations research, and accounting and financial management. Over the period November 2001 to February 2002 it was offered to students as an off-campus-only summer semester unit for the first time. The student cohort included students who would normally study on-campus during standard semesters only, students who would normally study off-campus, and a group of students based in Singapore. The summer semester period is notionally only 10 weeks in duration, compared to the standard semester duration of 13 weeks. In practice, the summer semester period incorporates a two-week Christmas/New Year period when the University is closed, as well as being a popular period for student holidays and/or vacation work; hence, the actual time for students to study effectively is often considerably less than the standard semester duration.

Time-shortened course delivery formats were first developed for the delivery of standard courses during the shorter summer semester (Daniel, 2000). Research indicates that a wide range of discipline areas can be successfully delivered in a time-shortened format, including the liberal arts, education, and courses involving computational skills, such as mathematics, science and economics (Daniel, 2000). It is suggested that intensive courses are best offered to upper year level students, since these students should already have the required foundation knowledge in the discipline area and the maturity to effectively use the time-shortened study period (Brown, 1992). Though the identified sources don't specifically refer to off-campus delivery, they do suggest that the

chosen unit, SEB311, has the characteristics for successful delivery over summer semester.

To assist students to study the unit off-campus and in a compressed time-frame an on-line unit site was created using the TopClass (WBT Systems 1999) online teaching and learning management system. The unit site included:

w general advice—getting organized, submitting assignments, preparing for the exam, etc;

w unit guide—containing administrative information, assignment details, etc;

w suggested answers to self-study review questions in the printed course material;

w suggested answers to semester assignments (posted after the final submission date);

w past exam papers and suggested solutions;

w class announcements area for latest class news and information; and

w a class discussion area open to postings from all class members.

This was the first time that this unit had been offered over summer semester, and the first time that the TopClass system had been used for the on-line support of a unit in the School of Engineering and Technology. To evaluate the effectiveness of the TopClass system in assisting students to complete their SEB311 summer semester studies, a pre-test/post-test survey was conducted.

Methodology

All enrolled students were mailed a questionnaire at the commencement of the semester that sought responses under the following categories:

w demographic information—age; gender; course of study; location of study;

w summer semester studies—previous experience; previous study mode; reason for taking;

w on-line learning support—previous experience; was it beneficial?; what should be provided?; and

w on-line access—do you have Internet access? Where?

This was followed at the end of semester with another questionnaire that sought responses under the following categories:

w demographic information;

w summer semester studies—goals achieved?; how did it compare to normal studies?; and

w on-line learning support—compare TopClass to other on-line support; what on-line resources did you actually use? In what way could on-line support be improved?

For both questionnaires, students were provided with a reply-paid envelope so their completed questionnaire could be returned at no cost to the student. As required by University research ethics procedures, participation in the survey was anonymous and voluntary.

Results and Discussion

Response Rate

For the start-of-semester survey, 34 valid responses were obtained from a total class enrolment of 66, giving a response rate of 51.5%. For the end of semester survey 34 valid responses were obtained from a total class enrolment of 64, giving a response rate of 53.1%.

Demographic Information

The following statistics were collected from the start-of-semester survey:

Age: mean age 25.6 years; standard deviation 6.05 years; age range 19 to 38 years; and median age 25 years.

Gender: female 14.7%; and male 85.3%.

Courses of study: Bachelor of Engineering 53.1%; Bachelor of Technology 37.5%; and Other 9.4%.

Study location: Australia 76.5%; and Singapore 23.5%.

The gender, course of study, and study location characteristics of the entire commencing class group were known, permitting a comparison of the population and respondent groups. The proportion of females in the population was 9.1%, which was not significantly different from the respondent group ($x^2 = 0.723$, $P > 0.39$ d.f. = 1). The proportion of BE

students in the population was 68.2% and the proportion of BTech students in the population was 25.8%, which was not significantly different from the respondent group (x^2 = 2.108, P > 0.34 d.f. = 2). The proportion of Australian-based students in the population was 80.3%, which was not significantly different from the respondent group (x^2 = 0.199, P > 0.65 d.f. = 1).

The following statistics were collected from the end-of-semester survey:

Age: 25.3 years; standard deviation 6.50 years; age range 19 to 42 years; and median age 23.5 years.

Gender: female 14.7%; and male 85.3%.

Course of study: Bachelor of Engineering 75.9%; Bachelor of Technology 20.7%; and Other 3.4%.

Study location: Australia 73.5%; and Singapore 26.5%.

The gender, course of study and study location characteristics of the entire end-of-semester class group where known, permitting a comparison of the population and respondent groups. The proportion of females in the population was 9.4%, which was not significantly different from the respondent group (x^2 = 0.633, P > 0.42 d.f. = 1). The proportion of BE students in the population was 70.3% and the proportion of BTech students in the population was 25.0%, which was not significantly different from the respondent group (x^2 = 0.313, P > 0.85 d.f. = 2). The proportion of Australian-based students in the population was 79.7%, which was not significantly different from the respondent group (x^2 = 0.484, P > 0.48 d.f. = 1).

The gender proportions in both the commencing and final respondent groups compare closely to the reported overall female participation rate in Australian engineering undergraduate studies of approximately 16.05% (Department of Education Training and Youth Affairs, 2001). The good match between the demographic characteristics of both the commencing and final sample and population groups suggests that valid conclusions about the commencing and final population groups can be inferred from the respective respondent groups.

Summer Semester Studies

At the commencement of the semester only 8.8% of respondents reported that they had studied a summer semester unit previously, though 50.0% of respondents reported that they had studied in the off-campus mode previously. The vast majority of students (91.2%) indi-

cated that their reason for undertaking summer semester studies was to accelerate the completion of their study program. Another 5.9% indicated that they were attempting to catch up a failed unit. A single respondent (2.9%) indicated that he/she was taking the offered unit over summer to make more room in the study program in the following semester so that he/she could enroll in night school classes. For most students, summer semester provided the opportunity to accelerate their studies at a time that was convenient to them.

At the completion of the semester, 94.1% of respondents indicated that they felt they had been successful in achieving their original goal for studying a summer semester unit. Respondents were asked to indicate if they thought studying in summer semester was better, worse or no different from studying in a standard semester. The responses received were: better 23.5%; worse 11.8 %; and no different 64.7%. Only a small proportion of students found summer semester to be inferior to studying in a standard semester.

On-line Learning Support

At the commencement of the semester, 67.6% of respondents reported that they had studied a unit previously that provided some form of on-line support; 32.4% of respondents had not. Of those respondents who indicated that they had studied a unit previously that provided some form of on-line support, all indicated that the on-line support had been beneficial for their study. Reasons cited included:

- w access to study resources and information;

- w access to model answers for problems;

- w ability to get a feeling for how other students are progressing;

- w receive latest/updated class information;

- w communication with the academic staff member(s) and other students;

- w improved response time;

- w universal access to resources – at home/at work/24 hours a day—7 days a week; and

- w on-line assignment submission.

At the commencement of the semester, respondents were asked to indicate what resources should be provided by on-line learning support from a six-item inventory, as well as listing any other resources they felt

were important. The proportions of respondents indicating the inventory items were important were:

w e-mail communication with lecturer: 88.2%;

w study tips/advice: 85.3%;

w discussion forum for all students: 79.4%;

w assignment details: 91.2%;

w answers to exercises/review questions: 97.1%; and

w class announcements: 79.4%.

Two statistically significant correlations between survey responses were found in the start-of-semester responses. Australian-based students were more likely (92.3%) than Singapore-based students (37.5%) to indicate that class announcements were important ($\tilde{}^2$ = 11.240, P = 0.0008 d.f. = 1). This is perhaps due to the fact that the Singapore-based cohort is accustomed to receiving a complete package of study materials, including study notes, textbooks and experimental kits, so that they can complete the study unit in a self-contained mode, without reference to additional external resources. On the other hand, the Australian-based students have to purchase their own textbooks, download the assignment details from a unit web site, and generally seek out additional study resources beyond those that are delivered to them.

It was also found that, at the start of the semester, those students who had previously studied a unit with on-line support were more likely (95.7%) to indicate that an on-line discussion forum should be provided than those students who had not previously studied a unit with on-line support (45.5%) ($\tilde{}^2$ = 11.468, P = 0.0007 d.f. = 1). This is perhaps because previous experience of studying units with on-line support is important in demonstrating the value of resources such as an on-line discussion forum.

Other on-line resources listed by commencing respondents as important included:

w past exam papers and solutions;

w feedback on assignments; and

w after-hours on-line tutorials.

Though not directly related to the TopClass system, one student wanted to make course enrolments and enrolment variations on-line. One area where the Internet has had a large impact on society in general is the provision of "e-services," and e-commerce in particular. Compared

to commercial enterprises, the education sector has been slower in offering e-services to students. Students are offered a wide array of on-line services and payment options from banks, phone companies and others; however, many students find that similar services are not yet available from their university or school. On-line access to payment of fees, purchase of textbooks, academic transcripts, course registration and other student services is still highly variable (Green, 2001).

At the completion of the semester, respondents were asked to indicate what on-line support resources they actually used in their summer semester studies, again based on a six-item inventory, as well as listing any other on-line resources they used. The proportions of respondents indicating the inventory items were important were:

w e-mail communication with lecturer: 38.2%;

w study tips/advice: 52.9%;

w discussion forum for all students: 32.4%;

w assignment details: 64.7%;

w answers to exercises/review questions: 76.5%; and

w class announcements: 44.1%.

A single statistically significant correlation between survey responses was found in the end-of-semester responses. Students who normally study in off-campus mode in a standard semester were more likely (61.1%) than students who normally study in on-campus mode (12.5%) to indicate that e-mail communication with the academic staff member was valuable ($\tilde{}^2 = 8.476$, $P < 0.0036$ d.f. = 1). This is perhaps due to the fact that students with prior experience of off-campus study have already developed strategies for overcoming barriers to communication with academic staff, and have found e-mail to be an effective means of achieving this. Those students who would normally study in on-campus mode in a standard semester, by definition, live geographically close to the university and, even though technically enrolled in off-campus study mode for the summer semester, may have nevertheless taken advantage of their proximity to the university to visit academic staff in person to have their questions answered, rather than resorting to e-mail communication.

Other on-line resources listed by respondents as actually used in their summer semester studies included:

w past exam papers;

w past exam paper model solutions; and

w assignment model solutions.

Comparing the actual usage of on-line resources to those considered important at the commencement of the semester, it can be seen that all actual ratings are significantly lower. However, the initial rankings of the resources correspond closely to the ranking of actual usage, with the first- and second-ranked resources (answers to exercises/review questions and assignment details) being the most used resources, and the lowest-ranked resource (discussion forum for all students) being the resource indicated as used least. The on-line resources with the highest indicated actual use are those likely to assist students in strategic study activities to improve their ability to solve typical problems and maximize their exam mark. This is also reflected in the "other" on-line resources indicated as actually used by respondents, particularly model solutions for semester assignments and past exam papers.

The on-line resource ranked as least important and used least in practice was a discussion forum for all students. While the discussion forum implemented for this exercise was not formally structured and student contributions were not compulsory, it was disappointing not to see the students make more use of the forum for student-to-student communication and collaboration. Research by the U.K. Open University into their "tutorial support model," where computer conferencing was used to replace telephone, letter and face-to-face communication, showed that "...students value the interaction with other students, as much as interaction with the tutor. They find it valuable to compare notes with their peers, to chat about issues tangential to the course and to create the kind of community usually only found on campus." (Mason & Bacsich, 1998, p. 250)

The lack of use of the discussion forum in this instance suggests that students will not necessarily create an on-line collaborative group of their own accord, without guidance and a pre-existing structure for such communication and interaction, and that the conduct and benefits of such on-line collaboration need to be explained and demonstrated by the academic staff responsible for them.

The School of Engineering and Technology provides a standard set of on-line resources for most study units, using a custom-built web system (Palmer & Tulloch, 2001). At the completion of semester, 85.3% of respondents indicated that they had previously accessed/used the standard unit web pages. Of those respondents who indicated they had accessed the standard unit web pages previously, they were asked to rate the summer semester TopClass system as better, worse or no different

compared to the standard system. The responses received were: 31.0% better; 6.9% worse; and 62.1% no different. Only a small proportion of respondents ranked the summer semester TopClass on-line system as inferior to the standard School unit web page system.

At the completion of the semester, respondents were asked to identify any ways in which the on-line support of their studies might be improved. The responses received included:

w more model solutions to past exam papers;

w provision of on-line tutorials; and

w one student noted frustration caused by two network outage periods during which the TopClass server was not accessible.

On-line Access

Respondents were asked to indicate their source of on-line access. Only three sources were indicated; home 91.2%; work 5.9%; and university 2.9%. The vast majority of respondents had Internet access at home. Less than 10% were reliant on others for their source of on-line access.

Student Academic Performance

Daniel (2000) reports that research indicates that student academic results from time-shortened courses are comparable to results from traditional semester-long classes. The unit SEB311 is also offered during the year in a standard semester-long format, so student results is available for this unit in both the standard and summer semester modes of offer. The academic results from semester one 2001 were compared to the results from the summer semester 2001/2002. The semester one class contains both on- and off-campus students; as the summer semester class contained only off-campus students, only the off-campus student results from semester one were used in the comparison. The mean mark from the semester one class was 71.2% and for the summer semester class it was 73.3%. There was no significant difference between these results ($F = 0.790$, $P > 0.375$ d.f. = 157). A comparison was also made of the grade distributions (fail, pass, credit, distinction, high distinction) between the standard and summer semester groups, this is presented in Figure 1. Again, no significant difference was found ($x^2 = 5.102$, $P > 0.277$ d.f. = 4).
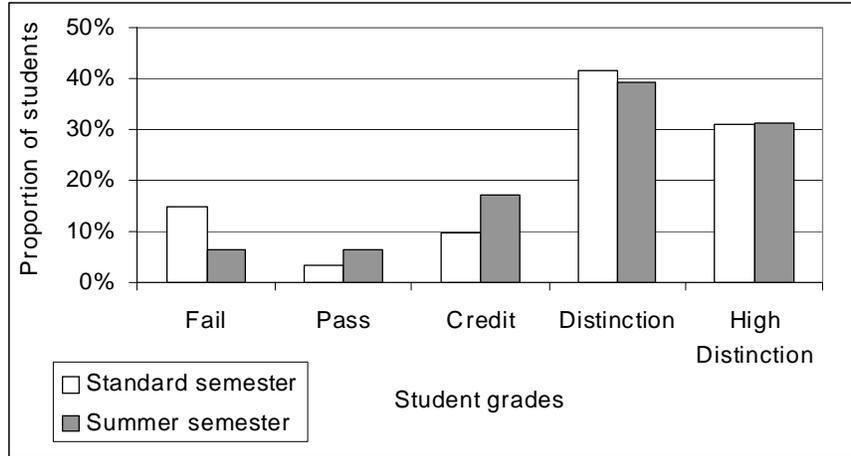
Figure 1. Grade distribution comparison between summer and standard semester classes

Conclusions

Most students were successful in achieving their summer semester study goals; their primary reported goal being to accelerate their study program; and only a small proportion felt that summer semester was inferior to studying in a standard semester. Prior to this exercise, all students who had used on-line support in their studies previously also reported that it had been beneficial for their study. The types of on-line resources ranked most highly by students were those that assisted in strategic study and exam preparation, including answers to review questions and past exam papers.

The on-line resource ranked as least important and used least in practice was a discussion forum for all students. This suggests that on-line collaboration between students will not necessarily arise spontaneously, and that students need more exposure to the benefits and conduct of on-line discussion forums. A statistically significant correlation between respondents reporting prior exposure to on-line support for study and also reporting an on-line discussion forum as being important supports the proposition that exposure to on-line discussion forums improves students' perception of their value.

Overall, it is concluded that off-campus students value on-line learning support resources, and that these resources improve access to information, improve communication between academic staff and students, and assist off-campus students to achieve their study goals.

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