Factors impacting on the effectiveness of computer-assisted courseware

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Abstract: *The level of satisfaction of computer-assisted tutorial courseware that is used as part of the undergraduate property and construction course at the University of Melbourne. It is important to determine if the computer-assisted teaching model improves the learning experience for students. This research examines the levels of satisfaction with a courseware model for teaching construction cost planning. The conclusions suggest that the advantages of the use of the model must be identified and actively supported throughout the whole course. In addition, further development of computer-based courseware is pointless unless the problems associated with their use can be minimized.*

Keywords: *Construction education, computer-based teaching, cost planning*

Introduction

The objective of the paper is to evaluate the usefulness of a computer-assisted tutorial exercise. The paper discusses the educational theory surrounding the advantages and limitations of the computer based courseware as a learning model. In addition, the future directions of computer-assisted teaching models are explored.

The ultimate aim of the course is to produce graduates that can inter alia, become effective construction managers. However, there are a number of subsidiary objectives that can be articulated, these include;

- To engage the students as active learners
- To provide contextual information on real world concepts and examples
- Encourage the acquisition of the skills necessary to undertake construction projects
- To link principles with current construction practice

Teaching Environment

The University of Melbourne offers undergraduate courses in property and construction as a single undergraduate degree and also as course within a number of double undergraduate degrees including; architecture, commerce, geomatics-engineering and law. The subjects offered must accommodate several discrete cohorts of students that may have different

perceptions of the value of the subject to their needs. In addition, class sizes are large, approximately 100 students, and site visits are difficult to organise, limiting the ability of students to obtain information about the context of the subject.

There are many educational difficulties in teaching undergraduates in construction. For example Kajewski (1999) suggested that large class sizes, tight timetables, busy site management, distant sites and site safety concerns have drastically curtailed such useful opportunities for a close up appreciation of construction processes.

This is impacting on the ability of modern undergraduates to understand the necessary contextual issues associated with cost planning. Many authors have stated that a contextual understanding of the problem is an important step in the learning process (Ramsden ,1988). However, teachers in construction management courses are increasingly having little success in providing students with an effective contextual experience in construction.

Background to computer-assisted teaching

Past research has shown that computer-assisted models can provide a worthwhile addition to the teaching aids used in the undergraduate subjects Menser (2001). For instance, computer courseware provides many advantages over traditional teaching approaches, including;

- Ability to undertake the exercise at times convenient to the student,
- Opportunity to repeat the exercise a number of times,
- Ability to interact with the computer model, and
- Capacity to be used by large class sizes.

Thus, computer assisted learning approaches have a much greater flexibility which may provide a better learning experience. However, computer based courseware is not without its own problems. Research by Oriogun (2001) showed that many aspects of the computer model are not well received by users. This had a very large impact on the ability of the courseware to deliver effective learning. Their results showed that 67% of the evaluators perceived the web based course provided by the University of North London was "unusable" for a variety of reasons, including:

- Ease and simplicity or use,
- Loading time, and
- Design concept

Menser (2001) also showed that many factors impacted on the courseware's effectiveness. Computer-based tutorials can only be used for the practice of low-level skills. Although there is some standard feedback dialogues, lecturers bring an insight into the way in which the student is approaching the problem. The face-to-face contact allows the personal intuition of the teacher to guide the student down the correct path. For instance the authors stated, "when students enter a wrong answer, it is usually wrong for good reason … students found that they need to talk to lecturers about questions arising from the computer-based problem." (Menser, 2000)

The use of computer-based tutorial exercises are best used as a supplement to an existing course, instead as a replacement for face-to-face teaching. Teaching needs enthusiasm and its effectiveness is dependent on creating that environment. "If the software is going to be used in places that are just intent on saving money, the lecturers have no interest in doing the teaching, the students (in turn) will sense the lack of enthusiasm, and just won't want to do it. " (Menser, 2001)

The term "useful" is defined as "producing or able to produce good results, and highly creditable or efficient" (Oxford , 1987). This implies that students believe that the computer-assisted model is worthwhile to the learning process. The model is designed to generate the following learning outcomes:

- Understand what an element represents.
- Know how to apply elemental cost planning techniques to a simple building.
- Understand the role of cost planning as a means of managing design costs.
- Appreciate some of the factors that impact on price.

Proposed Learning Model

Students are required to reach an understanding of the cost planning process and to develop some skill in the use of cost planning. A computer-assisted courseware tutorial exercise has been developed to enhance the learning process. The courseware is web based and has some degree of interactivity.

The objective of the exercise is to demonstrate how cost planning is achieved for a small building project. Students are required to prepare a detailed report on the cost of the building based on detailed information. Students are then required to reconcile the Elemental Cost Plan report with the cost of other similar buildings. Students are provided with detailed information on the building including some photos of the building under construction. Information provided, includes: floor plans, sections, elevations, details, specifications, and cost data. The task requires students to:

- Measure the Fully Enclosed Covered Area
- Measure the Unenclosed Covered Area
- Choose an Elemental Unit Rate from the cost data.
- Calculate the total building cost and percentage cost of each element
- Prepare a cost plan report

Research Instrument

The principle objective of the research was to determine the usefulness of the computer-assisted model for teaching cost planning. An expert on research design, Dr Som Naidu at the Multimedia Education Unit, University of Melbourne, assisted with the design of the research instrument. A number of instruments were examined, but in the end a questionnaire was chosen as the method most likely to achieve the best results.

There are many advantages of questionnaires, including; there is generally an absence of interviewing bias, and respondent is free from any pressure of being observed and possibly answer the questions more honestly. (Malhotra, 1993). This is particularly important because the students need to be sure that their responses do not form part of the assessment for the subject.

Care was taken with formation of questions to create a non biased survey to ensure respondents were not influenced in anyway. The general instructions provided with the questionnaire included an introduction to the questionnaire's purpose, assurance of confidentiality, and how and when to return the questionnaire. The questions were grouped into sections, to help structure the questionnaire and provide a flow, and both positive and negative items were intermingled to avoid leading the respondents.

Based on past research a survey was developed comprising four (4) questions that are used to evaluate courseware. It was assumed that approximately 10 minutes would be as much time

as the respondents would be willing to devote to the whole exercise, including the brief introduction.

The final questionnaire was individually issued to each enrolled student during a tutorial session. The questionnaire contained three parts, (A) demographic information about the course enrolment of the respondent, (B) attitudes about the usefulness of the courseware and (C) comments. A copy of the questionnaire is included in the Appendix. The questionnaire was given to the 66 students enrolled in 702-361 Introduction to Cost Planning. There were a total of 60 that returned valid questionnaires giving a response rate of 91%.

Results

The results of the questionnaire are summarized in Table 1, and show that students generally found the courseware to be useful. All scores shown in Table 1 are above a score of two (2) out of three and therefore indicate that student's perceived that the courseware to be useful.

Courseware Attributes	Average Score (1 to 3)
Clarity of the task at hand	2.3
Ease of use	2.6
Simplicity of format	2.5
Visual appearance/design concept	2.5
User interface	2.4
System feedback	2.2
Ability to do in own time	2.8
Ability to repeat the exercise	2.6

Table 1: Student opinion on the "usefulness" of the computer-assisted tutorial exercise in meeting the "Learning Outcomes"

The results in Table 1 showed that the most well received attribute of the courseware was its ability to be done in the student's own time (2.8). Other attributes that also scored highly include Ease of use (2.6) and ability to repeat the exercise (2.6). The least useful aspect of the courseware was the ability to provide feedback (2.2).

Students enrolled in the subject were also probed about the difficulties that they experienced in using the courseware. The results in Tables 2 and 3 indicate their perceptions of the negative aspects of the computer-based learning exercise.

Courseware Attributes	Average Score (1 to 3)
Clarity of main page layout	2.3
Task page layout/design	2.4
Ease of use of Drawing page	2.2
Notes page layout/design	2.4
Ability to return to home page/navigation	2.3

Table 2: Student opinions on the difficulties experienced in using the computer-assisted tutorial model

The results in Table 2 show that all scores are over two (2) of three, which were labelled as good to excellent. In other words, in a similar way to the first set of questions, students did not generally have a negative attitude to using the courseware, and did not perceive that it performed poorly. Nevertheless, the least impressive characteristic of the tutorial program was the ease of use of the drawings page (2.2).

The next section of the questionnaire asked students to indicate the amount of time consumed in undertaking the exercise. The survey asked students whether they perceived the time taken was in a range from Short (1) to Too long (3). The results (Table 3) show that average scores were less than two (2) out of three, and therefore indicate that they believed that the courseware was not overly time-consuming. The courseware seemed to be working efficiently, and did not suffer from downloading problems.

Courseware Attributes	Average Score (1 to 3)
Loading time of exercise	1.7
Download of spreadsheet	1.5
Time taken to complete the spreadsheet	1.9
Time taken to answer the questions	1.9
Printing time	1.7

Table 3: Student perception of time consumed in undertaking the exercise.

The students were also asked to comment on the usefulness of the courseware, and many interesting responses were given. The comments were coded into two groups, those which were generally positive and those that were negative. In other words, comments that indicated that the tutorial exercise enhanced student learning was classed as positive for computer-based delivery, and those comments that were critical of some aspect of the experience were considered negative. Typical comments and anecdotes provided by students are included in Table 4.

Positive Comments	Negative Comments
The task was very clear and simple to do	The task was too easy and simplistic
The computer exercise could be done at any place and time.	Computer based exercise does not allow questions to be asked.
The assignment should allow for on-line submission	There were many discrepancies between the specification and the drawings
Written information is sometimes easier to understand for a non-English speaker than information presented verbally.	Drawings were not easily visible, dimension were difficult to read.
The computer exercise provided a practical application of the theoretical information taught in class.	The assignment took too long and should be worth more than the marks allocated

Table 4: Typical examples of supportive and critical comments

The results indicated that students were generally pleased with the effectiveness of the computer-based tutorial exercise. A number of positive and negative comments pointed out areas which need consideration in order to improve learning outcomes. The next section of the paper discussed the implication of the findings, and suggests what should happen in the future.

Discussions

One of the principal aims of this paper is to determine the effectiveness of computer-based courseware as an educational tool. The advantages of the using computer-based models must be identified and in addition, further development of courseware is unlikely to be useful unless the problems associated with their use can be minimized. As previously mentioned the evaluation of the usefulness of the courseware was determined by a questionnaire that was completed by enrolled students. The results of past research by Menser (2001) indicated that:

- Computer-based education is best used for the practice of low-level skills (Level of understanding),
- The face-to-face approach allows the personal intuition of the teacher to guide the student down the correct path (Face to face learning)
- Teaching needs enthusiasm and its effectiveness is dependent on creating that environment (Teacher commitment)

Level of Understanding

The results of the research indicate that students are, in general, satisfied that the computer-based exercise achieves what it set out to do. Students indicated (Table 1) that the exercise met the learning objectives set in advance, and therefore can be considered a successful learning experience. It may be reasonable to suggest that the learning objectives were not overly ambitious, but it has been argued by Menser (2001) that computer-based teaching tools do not deliver good results when there is a high level of understanding required.

The tasks given to students required them to measure and price a simple building, and this process had been demonstrated in advance during the lecture series. This aspect of the process seems to have worked successfully, the students indicated that it was useful for the exercise to be done in the student's own time and there was an ability to repeat the exercise a number of times.

Because the use of computer allows for repetition there may be some advantages for students with poor language skills. One comment suggested that "written information is sometimes easier to understand for a non-English speaker than information presented verbally"

It can be seen form the comments provided in the survey that many students enjoyed the learning experience. However, one student admitted that "The task was too easy and simplistic"; possibly the task was tedious for some. This indicates that computer-based learning models are best used to support other teaching modes. It is likely that an over use of these approaches can become long-winded and boring for many students who seek to be further enriched.

Face to face learning

Teacher-centred learning is particularly useful for situations where the delivery of theory is important. In this situation the lecturer can direct students along logical paths in order to reach certain rational outcomes. This approach allows students to engage with the lecturer.

The use of face-to-face lecturing has many advantages, one student stated "I don't get on with computers, they don't talk back, and you can't ask them questions"

The use of computer-based models is often less advantageous than "chalk-and-talk" styles when theory is being taught. This is because the student cannot engage with the computer freely, unless the computer-based solution is very highly structured. Respondents to the questionnaire were critical of the feedback that they got from the courseware, and it is likely that further development in this area would be useful. Instead, the computer exercise should provide a practical application of the theoretical information taught in class.

In addition, it is important to take special care that any documentation provided must not contain ambiguous information that may confuse the student. Frustration and confusion is likely to cause the student to disengage from the learning process, and this may lead to dissatisfaction. Another comment that added weight to this notion was that the screen size did not allow easy viewing of tutorial content, the student said, "drawings were not easily visible, and dimension were difficult to read"

Teacher commitment

The evaluation process has clearly demonstrated that the effectiveness of the computer-assisted courseware is partially dependant on the commitment of the teaching staff. Past research (Menser, 2001) indicated that good learning environments are those where a teacher is creating the correct educational environment.

The success of the courseware is conditional on the strategic use of software for learning exercises that maximize the effectiveness of the computer. It will not replace face-to-face learning, and is likely to fail if it is used in that manner. Its effectiveness is dependent on actively supporting teaching aims throughout the whole course.

Computer based teaching methods require a considerable amount of planning before commencement of the subject, and the time commitment is not insignificant. It is possible that time and resource limitations are one of the key issues facing the future development of courseware within universities.

Conclusions

The use of computer-assisted delivery of course material seems to be an appropriate and effective method for the students undertaking a course in construction cost planning. The results of the evaluation of the courseware proved positive, with most students indicating that the program had been a useful aid to understanding the material.

However, evaluation of the software showed that there were a number of limitations to the system. Many students commented on the inability of computer to provide timely feedback if further explanation is required. It is possible that if some students become frustrated with the use of the courseware, that they may 'turn-off' from further learning and disengage themselves from the experience. It has become obvious from the evaluations done is this research that the level of disengagement needs to monitored and steps should be taken to reduce it if appropriate. For instance it may be necessary to run further 'face-to-face' tutorial sessions to follow up any issues that occurred during the computer sessions. It is hoped that this may assist some students to realize the benefits of the courseware.

The next logical step would seem to be enhancement of the existing courseware. A number of opportunities emerged through the evaluation process, for examples: on-line help for common errors, better quality drawings possibly based on Computer Aided Drawing software, and limited use of email support.

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