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Introduction

Virtually everyone recognizes the situations where a decision made on short-term financial rationale has resulted in higher long-term financial costs, whereas, appropriate technical, safety, and financial considerations would have avoided the waste and served everyone better. The key is to somehow get more of the right information to decision makers in a manner that allows them to consider the ripple effects that one decision has on another (Shana, 1998). Balanced management is a key to success where decisions are made such that financial goals, technical needs, and safety factors and credibility issues are simultaneously considered and weighed. This balance expresses the desires of every stakeholder in the industry and, when it is achieved, everyone wins. Therefore, the first goal of this project is to bring real-world decision making from industry into the classrooms so that every student in the class can apply their classroom learning to understand and train in making decisions. We chose a case study method of instruction to achieve this goal.

Multi-media information technologies provide access to vast information sources, support safe discovery-based educational experiences, and more aggressively support peer-to-peer education. Studies report that the nonlinear systems associated with multimedia technologies are superior to linear paper-based systems in improving problem solving skills and increasing user satisfaction. Specifically, the nonlinear system enabled users to make faster and more accurate decisions on perceptual problem tasks than did the linear system (Ramarapu, et., al., 1997). Therefore, the second goal of this project is to innovatively use multi-media technologies to enhance the learning experience. We enhanced the case study by adding video, audio, photographs, and competency material to create a CD-ROM so that the students were provided a rich set of materials that described a real-world decision-making situation.

Many students lack the breadth of knowledge and skills that are fundamental to the practice of their profession. There is now a growing realization among educators of the need to put a greater emphasis on imparting higher-level cognitive skills (e.g., reasoning, critical thinking, decision making, problem identification, and problem solving). A variety of national reports have also stressed the importance of teaching such skills to all levels of students. The learning experience must move from lecture as a dominant mode to include a significant level of active learning approaches (Wilson, 1998). Therefore, the third goal of this project is to impart higher-level cognitive skills. The students were provided an opportunity to learn the CD-ROM courseware in an asynchronous manner by taking it home and working on it independently and in groups. They were then provided synchronous learning opportunities when they discussed the case study in the classroom. These learning opportunities resulted in perceived improvement of the students' higher-level cognitive skills.

Content and Presentation of Courseware

We worked with a power company and created a written case study entitled, "Della Steam Plant." The objective of the Della case study was to show that good decisions require that managers become involved in understanding unfamiliar technologies and strike a balance between technical, financial, and management issues. As we developed and tested the Della case study in the classrooms, we realized that creating a multimedia version of this case study would add to the learning experience of the students. Therefore, a CD-ROM was created to include photographs of the plant, equipment, competency materials on power plants and vibration technologies, on-line references, problem statement, and the decision facing the manager.

This courseware is not a stand-alone software that the student can use independently of classroom participation. The comprehensive learning experience consists of students working with the courseware independently (asynchronous learning) and working in the classroom as groups (synchronous learning). The students learn in an asynchronous mode when they view the material at their convenience. They learn in a synchronous mode when they work together as teams and make presentations in the class.

Major Educational Objectives

The major educational objectives of the CD-ROM courseware are for the students to (a) integrate

business and engineering issues by understanding that good decisions require striking a balance between technical, financial, credibility, and management issues, (b) synthesize and apply knowledge gained in earlier courses to solve a real-world problem, and (c) gain higher-level cognitive skills such as reasoning, critical thinking and problem solving.

Subjects for Experiment

The CD-ROM courseware was used in undergraduate operations management and engineering classes. It is planned to be used in introductory management and engineering classes. The CD-ROM has also been used with R&D managers and faculty members. The CD-ROM courseware has been used by 23 engineering students and 10 operations management students during Fall 1998.

Effectiveness and Specific Benefits

As part of evaluation of the effectiveness of this project, students were given two separate evaluation forms at the end of the case study. In addition, they completed an electronic journal that provided answers to specific questions on their learning strategies, teamwork, and effectiveness of the project. Evaluation I consisted of 24 bipolar descriptors. Because the four constructs derived from Evaluation I yielded substantial reliability levels (with anything above .60 considered acceptable), the 24 separate questions within the survey were organized and reported by four distinct descriptors of the case study. Indeed, the medians for all four constructs are well above a rating of 3, indicating that students rated the case study on the positive side of the continuum. In fact, as demonstrated by the two constructs with medians of 4.0, the students found the case study particularly important and valuable as well as relevant and useful--important elements in effective learning.

Evaluation II asked the respondents to indicate the extent of their agreement with 16 evaluatory statements on a 5-point Likert scale. Substantial reliabilities for Evaluation II suggested specific constructs, which made an analysis of the data manageable and meaningful. The perception of the students on the constructs of perceived skill development, self-reported learning, intrinsic learning and motivation, and learning from fellow students was above 3.8, indicating that the Della Steam Plant courseware appeared to be well received and educationally advantageous to the students.

Table 1 summarizes how the courseware met the goals and educational objectives discussed earlier taking into consideration the quantitative results, comments from the students, and comments from operations management instructors who used the courseware.

Innovative Features of the Project

The innovative and unique features of the project are that (a) it brings in real-world situations into the classroom through videos, audio clips, and photographs. The students are provided an opportunity to experience the problem as though they were in the plant. The use of multi-media courseware in addition to the written case study enhances the multi-sensory perceptions of the students by engaging both their audio and visual perceptions, (b) its use of multi-media technologies facilitates non-sequential processing of information by the students, thereby more closely reflecting their thinking patterns, and (c) it includes a rich source of additional learning resources on the CD-ROM including videos that describe the industry and on-line references. This makes it possible for the students to apply theories they have learned to the problem presented.

It captures the expertise and experiences of an inter-disciplinary team (including faculty members, graduate students, undergraduate students, and industry practitioners), thereby enhancing their asynchronous learning experiences.

Conclusions

The Della Steam Plant Case Study is unique in that the courseware supplements an instructor's capability to bring real-world decision-making to the classroom. The multimedia courseware supplements the classroom work and provides an opportunity for the instructor to share the real-world decision making experiences with the students without extra effort. The instructional features of the courseware are designed to make it as a friendly, interactive media that enhances the classroom experience. The videos and pictures used in the multi-media CD-ROM enhance the classroom discussion, written case study, and help bring real-world problems into the classroom. For example, the problem segment shows an engineer showing the severity of the vibration levels that occurred in the plant using a rotor kit and the consequential vibration and noise generated by the rotor kit. The demonstration of the severity of vibration that occurs with the increase in speed of the rotor brings the reality of the problem to the students.

This could not be achieved without a multi-media presentation.

The instructional use of this courseware is for business and engineering students. The instructor is provided a full menu of information that could be used to supplement the classroom discussion of the case study and help students see examples of other students participating in a discussion. The instructor could also play the solution part of the courseware thereby sharing with the students the decision made at the plant.

The intent of this courseware is to enhance classroom experience of students and help them participate and understand how decisions are made in the real-world. It is also designed to be a tool in enhancing their higher-level cognitive skills. We expect that widespread use of such courseware could lead to significant changes in the way students are educated. These students would be better able to realize that solving problems in industry requires balancing the technical, managerial, financial, and credibility issues. Given the increased attention paid to use of information technologies in classrooms, it is essential that similar courseware need to be developed for use in classes that emphasize manufacturing, information, operations, and engineering technologies, statistical methods, engineering principles, and decision science principles. The multimedia technologies provide us, the instructors, an ability to bring real-world decision making issues to the classrooms as has never been done before.

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Goals and Objectives	Methods Used in Courseware	How this courseware Achieved these Educational Objectives
Connect theories to real-world decision-making	Problem statement and solution on video, Videos of plant personnel, Audio clips of discussion, Photographs of machinery, Figures/charts used in the plant.	Quantitative analysis (significant scores on constructs of interesting and exciting, important and valuable, relevant and useful), Supporting statements from students.
Use multi-media technologies to enhance learning	Use of menus, Use of popular browser, Targets in various files, Links to research sites, Facilitates non-sequential access to information	Quantitative analysis (significant scores on constructs of instructionally helpful), Supporting statements from students, Operations management instructors who used the CD-ROM perceived that students were motivated.
Provide students an opportunity to improve higher-level cognitive skills	Availability of competency material, On-line references, Audio, Videos, Challenge in using the courseware	Quantitative analysis (significant scores on constructs of perceived skill development, intrinsic learning, self-reported learning, and learn from fellow students), Supporting statements from students, Statements from students who worked on the project.

Table 1: Goals and Objectives Met by Project

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