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Teaching a Real-World Decision-Making Process Using Information Technology Tools

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Abstract

The multi-media instructional material CD-ROM developed by the authors and their student team illustrates the decision-making process involved in maintaining a turbine-generator unit at a power plant. The authors worked with the power plant executives throughout the project period, which lasted over two years. Five alternatives were considered, with costs ranging from $1.1 to $2.3 million. The innovative and unique features of the instructional material are the following:

(a) During the project period, the authors made several visits to the power plant and recorded important segments of the decision-making process as they occurred. This process requires the students to consider economic, financial, management, information systems, technology, and engineering issues in analyzing the problem. The discussions were video taped and included in the multi-media CD-ROM to bring the problem to life in the classroom.

(b) Incorporation of the Expert Choice software in the CD-ROM provides the students with an opportunity to analyze the power plant problem in a realistic way and compare their solutions to the one the company eventually selected.

(c) The actual plant manager discusses the problem and provides the assignment to the student using videos, thereby encouraging them to become more deeply engaged in their roles as engineers and managers and improve their teamwork and decision-making skills.

(d) The effectiveness of the instructional materials was tested with different groups of students at several universities using summative and formative evaluation methods. This multimedia case study has now been used by about 2,600 business and engineering students. The results show that the students were excited by the assignment, finding the case study to be a realistic, real-world problem replete with open-ended possibilities and multiple solutions.

Introduction

Employers and top executives in companies want their managers and workers to be above average problem solvers, decision makers, and team players. For example, the National Aeronautics and Space Administration (NASA) is working to boost the decision-making skills of flight crews, as NASA discovered that more accidents involving flight crews were attributable to errors related to decision-making than to any procedure involved in the operation of the spacecraft (Dornheim, 2000). Employers and executives see an urgent need for development and enhancement of decision-making skills in their future employees. They are concerned about enhancing decision-making skills of students to enable them to handle the complex and interrelated issues that affect the performance and sustainability of companies in the 21st century (Rieley and Crossley, 2000).

In addition, past research has shown that female students have more negative attitudes toward engineering and technology than do males (Busch, 1995; Shashaani, 1994). These negative attitudes may explain the decreasing number of female students

choosing technical careers. Past studies have shown that a change in learning environments and the methods by which learning takes place might foster a change in this situation (Chanlin, 1999).

Therefore, we developed a set of innovative instructional materials that use information technology tools to play/display videos, audio, CD-ROM, photos, figures, charts, animation, expert choice software, slides, reports, and notes and provide opportunities for students to enhance and improve their decision-making skills. The material is in the form of a multimedia CD-ROM case study that provides opportunities for students to have hands-on experience solving a real-world problem and brings live into the classroom the complex decisions that had to be made by the executives at a power plant. In addition, it provides the students with an opportunity to apply the Expert Choice software. Learning to use this software to solve a real-world problem helps students understand the importance of different criteria and sub-criteria used in the decision-making process and also allows them to perform a sensitivity analysis by manipulating the variables involved in the process. Thus, the main objective of this instructional material is to provide opportunities for students to improve their decision-making skills.

Major Educational Objectives

The major educational objectives of this instructional material were to:

(a) Provide opportunities for students to improve their decision-makings skills,
(b) Introduce the complexity of real-world problems and show how companies are working in the information age,
(c) Improve higher-level cognitive skills (the ability to identify, integrate, evaluate, and interrelate concepts) of the students, and
(d) Identify whether the use of this material by female and male students leads to differences in perceived higher-level cognitive skills and, if so, seek to identify the factors that cause the difference.

Content

This case study was developed by a cross-disciplinary team of faculty members and students from the Department of Management and Mechanical Engineering with cooperation from the plant personnel at Crist Power Plant. The authors discussed with the plant personnel planning of the maintenance outage during the period January to August of the first year. They then visited the plant and observed the actual implementation of the decision during January to March of the next year. The authors worked with the managers to develop the decision model and priority charts used in the case study. All the interviews were taped and transcribed in order to create the material used in the case study.

Photographs depicting the maintenance performed on Unit #4 and videotapes showing the disassembly and assembly of the turbine-generator sets were recorded during the field visits. A video was created that showed the actual implementation of the decision during January to March. The technical material used in this case study has been checked with the literature in order to ensure that accuracy is maintained. In addition, a glossary of terms was created to help the reader. Although other methodologies for decision theory such as multiple objectives, trade-off analysis and bounded rationality exist in the literature, we chose to focus on providing the details of only one method, the Analytic Hierarchy Process, in this case study. We obtained permission from the Expert Choice company to incorporate their software in the multi-media version of the case study.

Organization

The multimedia version of the Crist Power Plant Case Study provides an interactive approach to analyzing the case study. The *first screen* welcomes the users to the problem. As the users continue, they come to the *problem statement* screen. There they can read about the problem or play a video. The navigation at the bottom of the screen has four buttons entitled *case study, tools, site map, and credits*. When they click on *case study*, they are led to a detailed menu that lists the *problem*, *alternatives*, *decisions*, and a*ssignment*.

The *problem screen* provides video and textual information about the people diagnosing the problem, information about excessive vibration, the problems with rotors, retaining rings, and front standard, and the concerns with respect to stator. If some of the technical terminology is not clear, the users can click on the highlighted links and they are provided with either a *visual* or *textual glossary* of terms.

The *alternatives screen* describes the five alternatives that were faced by Joe Martin, the Plant Manager. Tables and a chart detailing the cost information are also provided. Each alternative is summarized and cost information about it is provided. The *decisions screen* describes the decision making process. Information on the expert systems is provided. As the power industry is moving toward deregulation, the need for good decisions is emphasized. Then a link is provided to *expert choice software*. The users can work with different items on the menu bar in order to understand the decision model. If they go to the "Sensitivity-graphs" menu item, they can use the performance sub-menu to see the relative priorities of the alternatives, given that risk and cost are equally weighted. They can change the weightings of the risk and cost and see how the priorities change. They can also go to the risk sub-category and explore the sub-criteria. If they change the weightings of the sub-criteria, then the final priorities also change. They can view the data that is used to make the priorities by going to the "assessment" menu-item and the "data or pairwise" link under it. They can navigate through the software further by using the help button.

The *decisions screen* ends with a segment on "real-world decision making" where Joe states that he is paid to make the decision and is ultimately responsible. In the *assignment screen*, Joe tells the students what they are expected to do during the case study analysis and presentation.

The *tools section* of the CD-ROM provides the competency materials that can help the users in analyzing the case study. Videos showing basic principles of electricity production and topics related to deregulation of the industry provide the viewers with a macro-economic perspective. An *animation* segment is included that shows the steps involved in the process of taking apart the turbine-generator and putting it back together. *Textual and visual glossaries* provide the users information on different terminology used in the case. A *website screen* provides them with references that can be used in analyzing the case study.

A *SMET* (science, math, engineering, and technology) *link* is provided to the students. Using these screens, they learn the basics of topics such as mechanical resonance, statistics, graphs, and charts. For example, the *statistics module screen* discusses the concepts of parent population, set, sample size, etc. The *graphs, charts, and tables module screen* shows the details of these concepts and how they are used in the case study. A *site map* screen completes the CD-ROM. This provides the users with the ability to navigate to other screens by clicking on the appropriate button.

Presentation

A sample lesson plan that was used for this case study in an MIS class is shown in Appendix A. Depending on the nature of the class and the instructor, this case study has been administered over a period of one week, five weeks, or other periods of time. In addition, the instructional material has also been used in one-day faculty workshops. In this section, we will use the outline provided in Appendix A to show how this innovative instructional material is presented in an MIS classroom during a five-week period (weeks 3 through 7 of the course). During each week, one class period is used for lectures and another class period is used for working in a computer laboratory.

After introducing the course during week 1, the students are provided with information on teaming strategies during week 2. The team working experience is more fruitful if the group dynamic could reflect the cooperative nature of project development. Past literature has documented the effects of team-member personality on team performance (Jackson, 1992; LePine, et al., 1997). Therefore, we provide training on team working and group dynamics during this week. We use the DISC methodology to identify the personality types of each individual student in the team. This model has been widely used in business settings for the purpose of team building (*A Comparison of the Personal Profile System and the Myers-Briggs Type Indicator*, 1996). Based on its four personality factors: Dominance (D), Influence (I), Steadiness (S) and Conscientiousness (C), it can provide a useful predictor of team effectiveness. We also get the students to work on small team projects to illustrate the need for cohesion in the group to achieve good results.

During week 3, the Crist case study is explained and the students are introduced to the economics of the power industry. An individual assignment makes the students learn about the power industry and the impact of deregulation on the industry.

During week 4, lectures on decision-making tools, maintenance technologies, and ethical considerations are delivered. The students are asked to work in teams and requested to manipulate the variables in Expert Choice so that one of the alternatives becomes most preferred.

During week 5, each group is asked to defend a particular alternative and also to choose the best and worst alternatives. They are requested to use the Expert Choice software and ethical considerations material in developing slides and papers.

During week 6, the student groups make presentations and submit a write-up. Many of them are able to cut and paste graphs, photographs, and videos from the CD-ROM in order to make their presentations more interesting. They also use the Internet extensively in order to add new information about the maintenance strategies and incorporate other decision-aiding tools. The presentations and write-up are evaluated using a format generally used in case study evaluations.

During week 7, student groups are provided with feedback on the presentation performance and the write-up quality. An instructor's manual (CD-ROM) is used to show the students videos of the alternative actually chosen by the plant management, the implementation process used by the company during the 10-week outage, and the surprises that occurred during implementation.

The comprehensive five-week learning experience consists of students working with the instructional material independently (asynchronous learning) and working in the laboratories as groups (synchronous learning). Since they work as individuals and as teams, they learn the materials thoroughly. In addition, the student interactions during weeks 4 to 7 tends to be intensive and interesting, since the students have already viewed the CD-ROM and they become deeply involved in analyzing the material.

Level and Number of Students

This multi-media case study has already been used successfully in both business and engineering classrooms. The material has been used by about 1,100 business students in two universities and about 1,500 engineering students in several different universities. The business students used this material in an Introduction to MIS course in an MBA program, and in strategic management and MIS courses during their undergraduate programs. When the engineering students used this instructional material in their Introduction to Engineering and Engineering Design courses, they were either freshman or sophomore level students.

Effectiveness

Evaluation studies have been conducted over time in order to obtain feedback concerning the case study and the information gained has been used to improve the instructional material and the presentation process. Information was collected from several groups of students in order to evaluate the effectiveness of this material. The groups were:

(a) A control and experimental group of students (31 each) where the experimental group used the multimedia CD-ROM whereas the control group used traditional instructional materials.
(b) Business and engineering students in two different classes. Of the 85 participants in this experiment, 43 were business students and 42 were engineering students.
(c) Men and women in three different classes. Of the 140 participants in this experiment, 99 were men and 41 were women.

Students responded to three individual evaluation forms. Evaluation I consisted of 24 bipolar descriptors on a 5-point continuum (Constructs: Interesting, Valuable, Instructionally Helpful, Relevant). Evaluation II included 16 evaluatory items asking students to rate extent of agreement on a 5-point Likert scale (Constructs: Skill Development, Self-Reported Learning, Motivation, Communication Skills, and Learn From Fellow Students). The third form prompted open-ended responses. In addition, students submitted an electronic journal where they documented the learning process and the outcomes from the process.

For the second and third experiments, the earlier questionnaires were modified based on past studies (Hingorani et al., 1998; Goodhue and Thompson, 1995), thereby reinforcing construct validity. The students were asked to evaluate the effectiveness of the method in understanding a typical issue faced by a manager on a 5-point Likert scale (1 indicating a extremely negative rating and 5 an extremely positive rating). The students completed the questionnaires and submitted them along with their written comments. Cronbach alpha was computed for each construct to identify whether the items belonged together within a construct. Two major constructs, referred to as *learning-driven* (factor B includes items that measure items such as self reported learning, learning interest, learned from others, and challenging) and *content-driven* (factor C includes items such as timeliness, ease of use, quality, and locatability), were derived (Table 1).

Table 1. Constructs and Items Used to Measure Learning-Driven and Content-Driven Factors

Construct	Items
Factor B: Self Reported Learning (3 items)	Improved my understanding of basic concepts, learned new concepts, learned to identify central management and technical issues.[a,b]
Factor B: Learning Interest (3 items)	Discussed technical and managerial issues outside of class, did additional reading on technical and managerial issues, did some thinking for myself about technical and managerial issues.[a,b]
Factor B: Learned from Others (2 items)	Learned to value other students' point of view, learned to inter- relate important topics and ideas.[a,b]
Factor B: Challenging (4 items)	Successful in bringing real life problems to the classroom, challenging, helpful in learning difficult topics, helpful in transferring theory to practice.[a, b]
Factor C: Timeliness (2 items)	Task completed on time, case study reports delivered on time.[b, c]
Factor C: Ease of use (3 items)	Easy to learn, easy to use, had enough training to use the case study.[b, c]
Factor C: Quality (6 items)	Current, up to date, data needed available, useful, appropriate level of detail, sufficiently detailed.[c]
Factor C: Locatability (4 items)	Easy to find, easy to locate data, obvious, exact definitions of terms were available.[c]

[a] Hingorani et al., 1998; [b] Mbarika et al., 2001; [c] Goodhue and Thompson, 1995.

Two external evaluators administered the evaluation forms to the students at the end of the Crist Power Plant Case Study in order to evaluate the students' perceptions of the benefit of the case study. They took care to ensure that the students responded honestly and anonymously. The instructors of the courses were provided with the results of the evaluation only at the end of the quarter, thereby protecting the grades of the students. The evaluations represent the reactions of students toward various aspects of the Crist Power Plant Case Study project.

Control and Experimental Group of Students

Students were randomly assigned to one of two engineering design courses: an intervention class (N=31), in which case studies were used, or a comparison class (N=31), in which traditional practices were followed. Comparative data were collected from the students regarding learning strategies and motivations, problem-solving techniques, and grades. Responses were collected from the experimental class regarding the case study. Responses to electronic journal prompts were collected from the experimental class to capture problem-solving processes. The medians for the constructs used in Evaluations I and II for the experimental class are shown in Tables 2 and 3. All the ratings were highly favorable (above the neutral 3.0 rating), indicating students' approval of the case study instructional mode. Evaluations indicated that the students found the case studies to be particularly relevant and offered opportunities to learn from peers.

Analysis of the results comparing the two classes shows that students who do not use the case study method of instruction possibly develop more motivational strategies and rely on more extrinsic rewards. Students who use the case study method drew upon a wider array of learning strategies when completing the design course than their comparison counterparts.

Grades of the students were compared two semesters after they had completed the case study. The results of the analysis of the grades are shown in Table 4. These results show that the skills the students acquired in the case study course continued to be of use in future upper division courses, as demonstrated through course grades.

Table 2. Medians for Constructs in Evaluation I

Interesting and Exciting	Important and Valuable	Instructionally Helpful	Relevant and Useful
3.3	3.5	3.8	4.0

Scale: 1 – Strongly Disagree; 2 – Disagree; 3 – Neither agree nor disagree; 4 – Agree; 5 – Strongly agree

Table 3. Medians for Constructs in Evaluation II

Perceived Skills Development	Self-reported Learning	Intrinsic Learning and Motivation	Learn from Fellow Students
3.8	3.7	3.7	4.0

Scale: 1 – Strongly Disagree; 2 – Disagree; 3 – Neither agree nor disagree; 4 – Agree; 5 – Strongly agree

Table 4. Results of Analysis of Grades of Experimental and Control Class

	Grade Course	GPA 1 Quarter After Course	GPA 2 Quarters After Course	Cumulative GPA
Experimental class M	3.08	3.03	3.39	2.99
Control class M	3.48	2.89	2.80	2.79
T	2.76	.26	8.56	1.78
P	0.1	.61	.01	.19

Comparison of Business and Engineering Students

This case study was administered to both engineering and business students over a one-and-a-half year period. The results of the perceptions of the students are shown in Table 5. The means show that the business students perceived the value of the multimedia case studies higher than the engineering students on most of the constructs. This was a surprising result, given that the case study had strong engineering content. The result might be due to the inclusion of the Expert Choice software in the CD-ROM.

Table 5. Results of Comparison of Perception of Business and Engineering Students

Construct	Mean and s.d. for business students	Mean and s.d. for engineering students
Higher Order Cognitive Skills Improvement	4.02 (.44)	3.65 (.86)
Self Reported Learning	3.66 (.53)	3.58 (.85)
Learning Interest	3.69 (.75)	3.26 (1.04)
Learned from Others	4.012 (.48)	3.54 (.81)
Challenging	4.09 (.41)	3.61 (.84)
Timeliness	3.99 (.56)	3.52 (.94)
Ease of Use	3.49 (.49)	3.31 (.75)
Quality	3.29 (.19)	3.24 (.49)
Locatability	3.75 (.42)	3.50 (.62)

Scale: 1 – Strongly Disagree; 2 – Disagree; 3 – Neither agree nor disagree; 4 – Agree; 5 – Strongly agree

In addition to the good evaluations received, we observed another interesting fact. We ran the Crist Case Study without providing access to the Expert Choice software or its results during 1998 and 1999 in both engineering and business classrooms. Business students preferred alternative 5, which meant buying a new turbine-generator unit for the plant. They chose this option because they were reluctant to repair specific parts of the unit; they found it easier to replace the whole unit, thereby solving the problem without thorough analysis. Engineering students, on the other hand, chose options 3 or 4, which were much closer to the one selected by the plant manager. However, they had difficulty in communicating their choice to a non-technical manager and convincing him/her to go with the option they chose. At this stage we obtained an agreement with Expert Choice Inc., to incorporate their software in the CD-ROM.

This modified case study incorporating Expert Choice was run during Spring and Fall 2000 and 2001 in both engineering and business classes. As shown earlier, the Expert Choice software recommended choosing either option 4 or 3. Once given this exposure and the ability to work with the software, both the groups independently generally chose option 3 or 4 and provided excellent reasoning why their selection was the correct one. This result made us realize that without exposure to case studies that integrate business, information technology, and engineering issues in a decision-making process, future business leaders are likely to choose simpler solutions over the most cost-effective solutions. The software also helped engineering students to communicate effectively with a non-technical manager, giving a scientific foundation for their decision when solving complex technical problems.

Study of Impact of Gender on Use of Multimedia Case Study

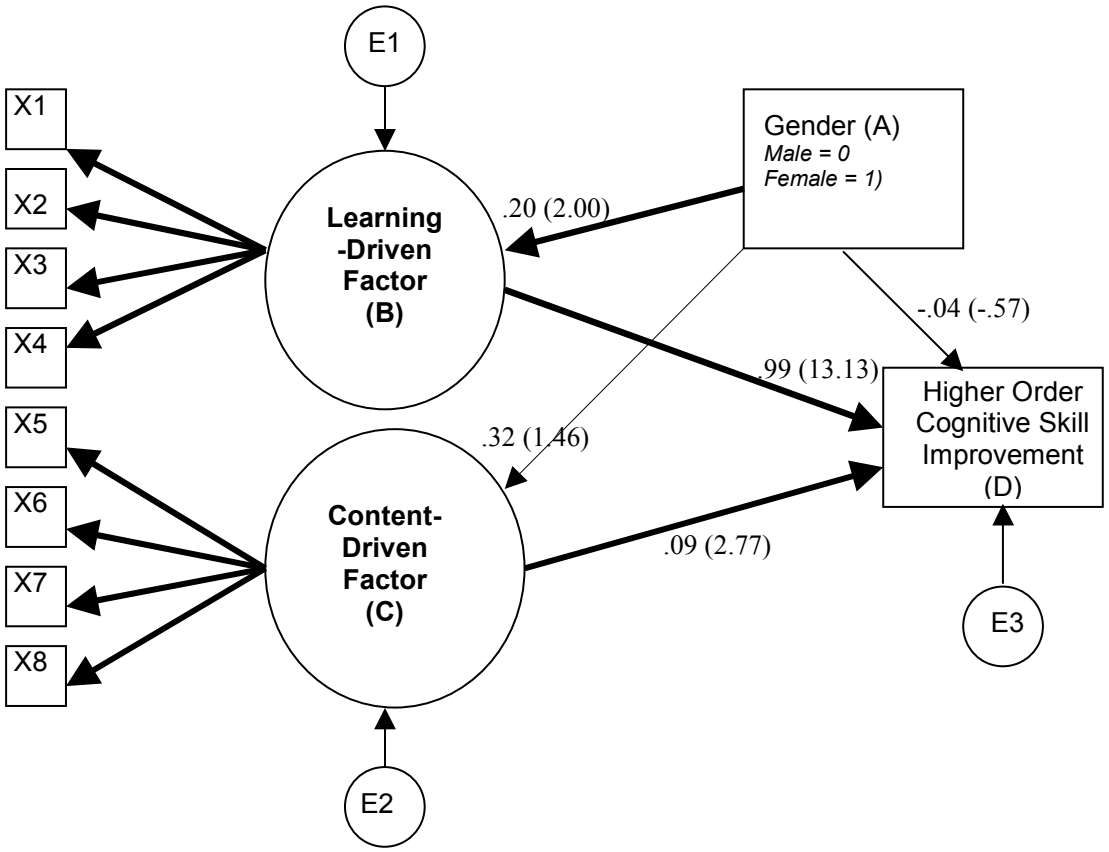
A structural analysis model was developed in order to study the impact of gender on the levels of understanding and interest in solving a real-world problem through the use of a multimedia case study. The gender construct (A) in this experiment was manipulated by a two-dimensional variable: female versus male students (Figure 1). Higher order cognitive skills improvement (D) was measured by a set of items that were validated in earlier research studies. The constructs and items corresponding to Learning-Driven (B) and Content-Driven factors (C) were derived from earlier studies published in the literature and are shown in Table 1.

The Amos program was used to compute the coefficients and t-statistics for each of the relationships in the research model. Figure 1 presents the results of the factor loadings and t-statistics used to evaluate the direct and indirect relationships between gender and higher order cognitive skills improvement. The figure shows that the indirect relationship between gender and higher order cognitive skills improvement is positive and significant for the learning-driven factor (AB, BD). As shown in Figure 1, the path coefficient is 0.20 and there is a t-statistic of 2.00 between gender (A) and this factor (B). The path coefficient between the learning-driven factor (B) and the higher order cognitive skills improvement (D) of .99 is high, as is the t-statistic, 13.13, which is well above the cutoff value of 2.

The result from the Amos program as well as the means and standard deviations of the responses of the students shown in Table 6, indicate that the female students perceived better higher-order skills improvement (4.00 versus 3.70) when they used the multimedia CD-ROM compared to male students. In addition, they reported that the learning-driven factor was a significant reason for this improvement. Comparison of the constructs under this factor shows that the female students perceived higher values than the male students for most of the constructs (self reported learning: 3.80 versus 3.61; learned from others: 3.97 versus 3.73; and challenging: 4.01 versus 3.78). In this regard, female students perceived that multimedia materials were more successful in bringing real life problems to the classroom, teaching difficult management and engineering topics, and transferring theory to practice.

Table 6. Descriptive Statistics for the Female and Male Students

Factors	Constructs	Mean (s.d.) for Female Students	Mean (s.d.) for Male Students
Factor D	Higher Order Cognitive Skills Improvement	4.00 (.52)	3.70 (.60)
Learning-Driven Factor (B)	Self Reported Learning	3.80 (.67)	3.61 (.66)
	Learning Interest	3.00 (.85)	3.20 (.82)
	Learned from Others	3.97 (.56)	3.73 (.67)
	Challenging	4.01 (.58)	3.78 (.65)
Content-Driven Factor (C)	Timeliness	3.87 (.76)	3.67 (.79)
	Ease of Use	3.55 (.76)	3.45 (.69)
	Quality	3.51 (.48)	3.36 (.56)
	Locatability	3.64 (.64)	3.52 (.58)



Where: the t-statistics are in parentheses and Learning Driven Factor includes the constructs of X1 = self reported learning, X2 = learning interest, X3 = learned from others, and X4 = challenging

Content-Driven Factor includes the constructs of X5 = timeliness, X6 = ease of use, X7 = quality, and X8 = locatability

E1, E2 and E3 are Error Terms

Indicates Significant relationships and

Indicates Non-Significant relationships

Figure 1. Model Showing Relationship between Gender and Hgher Order Cognitive Skills Improvement

Conclusions and Future Research

This paper presents the development, testing, presentation, and evaluation of an innovative and multimedia rich CD-ROM that documents the decision-making process used by power plant personnel in maintaining a turbine-generator unit. Further use of this instructional material in other universities might motivate students to learn more about business, engineering, and other issues that form the core of organizational decisions. They may then be more willing to learn difficult and complex subjects in their curriculum and be able to apply the theories they learned in school when they go to work.

A possible future research is to provide a life cycle methodology for the implementation of this technique across a wider range of courses and case studies to include both technical and non-technical business IT related subject matter. A comparison to a control group not using IT tools in same curriculum would also be helpful. Another possibility is not to provide any alternatives and ask the students to explore the possibilities of other options. More samples could be used to assess the result and effectiveness

of the case study software. Keeping in mind that this case Study software is intended for Business students also, the teaching material /case study can be expanded to include areas such as Finance, Marketing, Accounting etc. A comprehensive case study can be developed and students can be asked to make decisions for the various departments of the company.

In conclusion, use of multimedia instructional materials in business classrooms have proven to be beneficial. The multimedia software that was discussed in the paper seems to be an excellent way of enhancing the decision making skills of students. Also this approach of case study analysis will help students in understanding the minute details of the company or the project and understanding about doing a cost benefit analysis. It shows direct application of integration of an IT tool to the instructional design of a technical course, with associated outcomes.

Table 7. Evaluation of the Instructional Material

Goals of Instructional Material (What Will We Do?)	How Did the Authors Achieve the Goals?	Evaluation in Classes by Students
Provide opportunities for students to improve their decision-making skills	CD-ROM captures the planning and implementation of the project through videos and photos. A copy of the Expert Choice software was included.	Provided a provocative and useful educational tool. Students valued the "decision-making process," and realized that there was "more than one way to reach the decision,"and were "impressed about the software."
Introduce the complexity of real-world problems and how companies are working in the information age	The Crist Power Plant case study was a $2.0 million project planned over two years and executed in three months.	The case study was found to be relevant, useful, important and valuable. A prominent theme was the real-life context of the problem, replete with open-ended possibilities.
Improve higher-level cognitive skills of the students.	Used case study methodology and provided opportunities for students to play the roles of engineers and managers.	Reported greater perceptions of skill development, learning, intrinsic learning and motivation, communication skills, and opportunity to learn from fellow students.
Identify whether the use of this material by female and male students leads to differences in perceived higher-level cognitive skills	A research model was developed to show the potential relationships between gender and higher-level cognitive skill improvement with two intervening variables.	Results show that when designing new learning environments, it is important for the female students to be challenged and have opportunities both to learn by themselves and to learn from others.

The evaluation results show that it is likely that without exposure to case studies that integrate business, information technology, and engineering issues, future business leaders might choose simpler solutions over the most cost-effective solutions.

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Appendix A. Course Outline

MNGT 4850: Competitive Strategies through Information Technologies
Target: Undergraduate students pursuing a major in MIS

Course Contents/ Objectives:

Large software and hardware systems continue to fail despite rapid advances in information technology (ISCC '99). Phil Condit, the Chief Executive Officer for Boeing insists that technical personnel in the future need to acquire four skills: communication, cost benefit, continuous learning, and collaboration. Despite progress on strengthening the bond between higher education and the needs of industry, a systemic customer-supplier relationship between the two sectors has not yet matured. **Therefore, the first goal of this course is to provide instructional materials that give you an opportunity to examine decisions faced by IS personnel and managers in actual companies. Discussions of these decisions would provide you with the ability to integrate theory, practice, and design**.

The teaching of domain-specific knowledge (e.g., specific subject matter such as differentiation, use of calculators, statistics, accounting, financial ratios, economic formulates, etc.,) has long been recognized as the primary objective of school and college education. The relative neglect of teaching higher-level cognitive skills is due to two ill-founded assumptions: (a) that these skills cannot be taught and (b) that they need not be taught. Evidence is accumulating that both assumptions are wrong: higher-level cognitive skills can be improved by training, and it is not safe to assume that such skills will emerge automatically as a matter of development or maturation. **Therefore, the second goal of this course is to further develop your higher-level cognitive skills**.

The means through which these goals are achieved in this course is through the use of multimedia case studies that have been developed by partnering with industries. Working in teams, you will have the opportunity to study and analyze the case studies in-depth. Thereby, you have an opportunity to synthesize the knowledge gained so far so that you can provide constructive suggestions for companies that are faced with major decisions. Working on the case studies will also expose you to concepts of ethics.

Tentative Schedule and Outline of Course Content:
Text Book:

Course Outline:

Week 1: Introduction
Course outline, Web page development, Introduction to WebCT
Chapters 1 & 3; Section 2-3.
Introduction, Decision Making Models
Week 2: DISC Instrument and teaming discussion
Class: DISC Instrument; Team formation

Week 3: Lecture: Crist CD-ROM tools ; Introduction to power industry; Crist Power Plant case study, Expert Choice.
Lab: **Individual Assignment (5 points):** Answer one question from the instructional materials and connect these answers to the charts provided at the end of the chapter. Your answers have to be justified based on data provided at the end of the chapter and updated using Internet research. Make a powerpoint presentation and upload this report to WebCT, Due on 3/5.
Objective: Learn about the power industry and impact of deregulation on the industry.
Week 4: Lecture: Decision making tools, Maintenance technologies, Ethical considerations
Lab, Crist CD-ROM
Group Assignment (5 points): Students will be assigned to different teams. Your group has taken over Mark's job at Crist Power Plant. As per the current priorities (risk=0.5, cost=0.5), alternative 4 seems to be the most preferred

(page 213). Your boss prefers alternative 1 and would like you to change the information in the Expert Choice to make alternative 1 the most preferred. Please work with Expert Choice to make this happen and write a note explaining the data that was changed to make it happen. Upload your report to WebCT.
Objective: Work with Expert Choice, a DSS.

Week 5: Lecture: Assign final group roles
Lab: **Group Assignment:** Each group will be given an alternative to defend, change the expert systems to make that alternative come out the best, and discuss the ethical issues that make that alternative attractive. Then, your group would discuss the best and worst options you perceive given that there are no external constraints. Prepare presentation and write-up.
Objective: Play roles of technical personnel and manager in making business decisions.

Week 6: Group presentations and write-up due **(15 points)**

Week 7: What happened? Feedback session
Test #2 (5 points), E-Journal #2 due (2 points): Feedback on Presentation

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Grading and Evaluation Procedures

Course Requirements: The course is based on mastering the course material, working in lab, and participating in case study discussions.

Grading (100 points):
Case Study Analysis: 65
Lab assignments: 30 points
Presentations and write-up: 35 points
Attendance, E-Journal: 10
Tests, Final Examination: 25
90 and above - A; 80 to 89 - B; 70 to 79 - C; 60 to 69 - D; Below 60 - F

Appendix B. Student Comments on "Crist Power Plant" Instructional Material

Achievement of Goal I: *Provide opportunities for students to improve their decision-making skills*

I learned about the Expert Choice software, before this I hadn't heard of any decision-making software. Also I learned about how important the engineering point of view is to the decision making process.

I think the decision making process that we used here will be useful in future careers. The ranking method of cost vs. risk will also prove useful in the field of engineering.

I was very impressed with the Expert Choice Software. I was amazed at the way decisions can be analyzed by the use of computer programs like this one.

I learned that there is more than one way to reach a decision. I felt that using the decision support software greatly strengthened our decision and that a decision should be made using more than just one method. Knowing that there are programs like expert choice to help engineers make decisions is reassuring and enables engineers to make the best decisions.

I learned that programs could be used to help make decisions based on high quality and low cost conditions. I am glad that programs can be used to make the decision of an engineer much easier

The one thing that I learned while doing the case study was that making a decision such as the one in the Crist Power Plant case study is not an easy decision. There were many decisions to choose from and all of them are good possibilities, you can narrow it down to a few but then to decide the best is a difficult task.

I enjoyed learning about the expert system and using it to help in choosing an option. It was nice to be able to graph and compare between the options simultaneously.

Achievement of Goal 2: *Introduce the complexity of real-world problems and how companies are working in the information age*

I have enjoyed both case studies very much. It is enjoyable working on them on our own [or] as a group. It offers much more mobility for the group to tackle assignments on their own. I also find this sort of material very intriguing as opposed to number crunching in other classes.

After completing the case study, I feel like I have become a more valuable asset to a future company. I can incorporate financial, future, and engineering issues and concerns into a decision. Before, I do not think I would have accounted for either short-term future or cost effectiveness. Now, I realize the importance of those issues and have become a better decision maker

I believe that if I were to interview with a company that is in the power producing industry I would be able to communicate with the interviewers better because of my work on this case study. I believe that knowing the basics of what that company does and my role as an engineer in their industry would give the interviewers a very good initial perception of my abilities and me.

I enjoy learning about a real-life situation and getting down in all the details. I like finding out the answer and seeing where I went right or wrong.

Achievement of Goal 3: *Improve higher-level cognitive-based problem solving of the students.*

I learned how important the engineer's perspective is to a management type decision. Without an engineer to say that something is going to work, what it costs doesn't mean anything. If it doesn't work, it is worthless to the company. This case study has helped me to be both a better engineer and problem solver.

I came away from this case study knowing substantially more than I did going into it. There is a great deal of everything that goes into decision-making. The business and technical issues are the main ones, but then those can be subdivided into many parts. Teamwork and good decision-making could easily make or break a plant in today's economy. Due in part to deregulation plants have to stretch a dollar to and beyond its limits.

I enjoyed the videos and picture provided on the computer. I thought they were helpful at making an accurate decision.

I enjoy working in the groups because I feel that this is how it will be in "the real world" Decisions will be made through processes like we are learning.

I learned that no matter what the problem is that there is going to be more than one alternative to solve this problem. This helped me to understand that I really need to improve my decision-making skills in order to be able to survive on the job.

Achievement of Goal 4: *Identify whether the use of this material by female and male students lead to differences in perceived higher-level cognitive skills.*

Female students had the following comments:

I have learned quite a bit about myself as [a] student while working through the case study. While the case study was quite different, it helped broaden my understanding of MIS concepts in the real world.

I learned that business decisions do not always have a certain answer that is considered "correct." You simply have to weigh the options you have and pick the one you feel best suits your needs. This sort of bothered me due to the fact that you may think and believe that the answer you have arrived at is correct but then down the road see that you were completely wrong.

As a problem solver I have learned that I can do the job given to me. I am now capable of sifting through material and organizing it to form an answer.

It has given me confidence in my ability to work on a project in different areas of business and industry and I learned that I must be able to learn the lingo and be able to work with different professionals.

I have learned that decision support systems could be especially beneficial to me in business since I often struggle with making decisions.

I was able to share my ideas, listen to those of others, and combine them to come up with a solution.

The case study gave me hands on experience with working with other students in order to accomplish a goal in a short period of time. I learned that I work well with other students and that that scenario works well in decision making because it brings more ideas to the table. That [working with others] is very critical in the real world.

It is kind of challenging to learn all those technical terms, however, the case study challenged me to learn a lot about how the power plant works. To this, I think it is good to have a very broad idea about different technologies.

It was all very challenging but figuring it all out is where I really learned the most…

As a problem solver I learned that everything must be taken into consideration when making a decision, you cannot leave anything out. As a business student I learned decision-making skills that I can take with me into the working field. As a MIS professional I have learned that there are many tools out there that can aid in any decision making process, such as the Expert Choice software.

This is preparing me for the "real world" and I think that colleges should do more things like this, so you won't be scared and unprepared when accepting a job.

As a problem solver, I have a much better understanding of the logic and thought that must be used to make rational and helpful decisions for companies.

I have learned about the impact of cost in certain situations, and this material gave a real-life example. I've learned that as a student I could some day be involved in many different industries and making decisions for these industries. This opens me up to the possibility of me being in one similar to that of the Crist case. This also reinforces how important technology is to every industry today.

I have learned about expert choice and its features. This could be useful if a company, which will require me to help them make choices, hires me.