Communications of the Association for Information Systems

Volume 8 Article 14

February 2002

Special Issue on the AMCIS 2001 Workshops: Bringing Real-World Issues into Classrooms: A Multi-Media Case Study Approach

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SPECIAL ISSUE ON THE AMCIS 2001 WORKSHOPS BRINGING REAL-WORLD ISSUES INTO CLASSROOMS: A MULTI-MEDIA CASE STUDY APPROACH

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ABSTRACT

This paper presents the results of research studies that use innovative educational materials to teach business and engineering courses. The innovation was part of a National Science Foundation grant to develop multimedia case studies that include photos, videos, and textual materials that bring real-world issues to the classroom. When these case studies were used in the classrooms, the students assumed roles of the managers and technical personnel discussed in the case and defended the position assigned to them. During this process, students are expected to integrate business skills with technical knowledge, enhance their decision-making skills, use principles of risk and cost management to solve problems, and enhance teamwork. Evaluation of the use of these materials in undergraduate classrooms shows that the students perceive enhanced opportunities for active learning and improvement of their higher-level cognitive skills. In addition, these case studies were shown to stimulate interest in non-engineering, female, and minority students about engineering and technical topics. The article is based on a workshop at the Americas Conference on Information Systems 2001 in Boston.

Keywords: innovative education, multimedia, active learning, engineering and IS, female students, minority students

I. INTRODUCTION

This paper describes the details of a workshop that was conducted at Bentley College as part of the 2001 AMCIS Conference. The objective of the workshop was to provide hands-on training to faculty members on innovative educational materials designed to help their students:

- Integrate business skills with technical knowledge
- Enhance their decision-making skills
- Use principles of risk and cost management to solve problems, and
- Enhance teamwork, thereby increasing productivity

The instructional materials and methodology used in this workshop were based on a curriculum development effort by the authors and funded by two grants from the National Science Foundation. The materials can be used in an undergraduate or graduate course in MIS, Information Technology (IT), Operations Management, and Computer Information Systems programs. Working with the multimedia case studies provides students with the opportunity to participate in decision-making scenarios involving real examples of the type of technical and non-technical issues faced by companies. The objective is to "celebrate information technology" and show how real-world issues can be brought into the classrooms using multimedia technologies. The students are able to apply the theories they have learned to solve a real-world problem.

The materials were designed to develop the students' ability to use the techniques, skills, and modern IT tools necessary in business. In one of the case studies, we incorporated expert system software so that the students receive hands-on experience working on a real-world problem. In addition, chapters on entrepreneurship, telecommunications, and operating systems in the written materials supplied to students provide valuable knowledge that business and MIS students will be able to use in the future. Using these materials in the classroom may also fulfill the requirements for the ISCC-11 course proposed by the ISCC'99 group (Lidtke et al., 1999).

The case studies and associated materials were chosen so as to show that:

- managers and technical personnel make decisions on a continuing basis and their decisions have a major impact on the performance of companies,
- the decisions have to be communicated effectively to employees and management, and
- the decisions have to include consideration of both technical and non-technical issues.

The next sections include discussions of the differences and similarities between traditional case studies and the multimedia case studies developed by the authors, as well as results from research studies using these innovative instructional materials.

II. UNIQUE FEATURES OF THE INSTRUCTIONAL MATERIALS

The instructional materials provide the technical knowledge that is needed to examine the case study and may be used by students with no prior knowledge of IT and business fundamentals. So far, the authors have developed a number of case studies as part of the NSF Project (www.auburn.edu/research/litee). A CD-ROM that includes videos, photographs and background materials to make the case more understandable accompanies each case study. The case study and relevant competency materials are published as a textbook with a CD-ROM supplement. Summaries of the case studies are provided in Appendix I. The next two subsections highlight the similarities and differences between these materials and traditional case studies.

SIMILARITIES WITH TRADITIONAL CASE STUDIES

The similarities between our case studies and traditional case studies such as those used in business schools are:

- The case studies bring theory, practice, and technical issues together in the classroom and examine decision-making scenarios in industry critically.
- There are many possible solutions to the case studies and different groups of students may recommend several options. The team interaction provides variety and stimulates the thinking skills of both the instructor and students. Students become involved in playing the roles of the technical personnel and managers in the case studies and identify with the material. Involvement leads to active problem solving, where students often become passionate in defending the option they selected. It also provides an opportunity for students to apply the theories and techniques they learned in other classes and internships to the analysis of the case study.

- The instructor's manual provides a possible solution to the problem posed in the case study and provides step-by-step instructions to the instructor in leading the case study in the classroom.

DIFFERENCES BETWEEN OUR CASE STUDIES AND TRADITIONAL CASE STUDIES

The major differences between these new-style case studies and the traditional case studies are:

- These case studies were developed for use in a wide range of undergraduate classrooms, whereas most of the well-known business case studies were specifically developed for use by MBA students.
- Students do not need any prior industrial experience, whereas the traditional case studies expect the MBA students to already possess a good understanding of business practices.
- The emphasis is on providing an understanding of business, technical, and engineering topics and how they interact in the real-world rather than just stressing purely business strategies.
- Competency materials are included that explain the technologies, business concepts, and other fundamentals so that a student with no background in the topic may also become proficient after using the case study supplements.
- Multimedia (video, audio, and photos) is used extensively to explain the instructional materials. Multimedia enhances the ability of the students to understand and retain the information.
- Case studies and competency materials are elaborate and include videos, links to websites, and color photos that extend beyond the textual materials presented traditionally.
- Instructors are provided guidelines on how the case studies could be tailored effectively for use in their curriculum. Videos are used to explain the problem and the possible solutions. In addition, forms are provided that could be used to evaluate the student teams. Appendix II details the help provided to instructors who use these case studies in their classrooms.

III. WORKSHOP CONDUCTED AT BENTLEY COLLEGE

The workshop was conducted at Bentley College in one of their state-of-the art teamwork rooms – the ACELAB. Faculty members representing over a dozen Universities attended the workshop. We were able to control and display the case studies from a central panel, and the participants sat around work tables that were each equipped with a large flat screen. In addition, the participants had the ability to work on the CD-ROMs using computers built into each table. The layout of the room made it essential that the faculty members work as a team. The Chick-fil-A case study was distributed to all 14 of the faculty members present, and they were given approximately an hour to work on the case study. They were split into four teams, one defending the choice of Windows NT, another defending the choice of Windows CE, the third being a consultant providing advice, and the fourth being the managers making the final choice. The hands-on experience was lively and interesting, simulating a team approach to problem-solving.

The faculty members who defended the NT solution had a wealth of experience and were able to describe the robustness and security of the system. The faculty members who defended the CE solution described how these systems are widely used and are relatively hacker-proof compared to the NT solution. After evaluating the opposing teams presentations, the consulting team made a presentation and recommended that the NT solution be implemented by the company. The management team discussed the options and made a presentation, finally choosing the NT solution. One of the members of that team had worked with NT systems extensively and was in favor of that solution.

At this point, we played the videotape to show why the company actually chose the CE solution for this problem. A lively debate ensued about the relevance of the different operating systems for a Point-of-Sale terminal selection. An unexpected result of the discussion was the focus on system security and the features offered by different operating systems designed to

prevent attacks by hackers. Overall, the workshop was well received by the participants. The layout and the facilities available at the ACELAB helped tremendously in forming and working in teams under severe time constraints on a complex problem.

IV. EVALUATION OF THE BENEFITS OF USING THESE MATERIALS

These case studies have been used by approximately 1,200 business and 1,500 engineering students during the past four years. Many different research studies were performed to determinethe possible benefits of courses taught using the multimedia case study materials discussed in this project. In this section, we provide a summary of the results obtained from the research studies that focused on:

- Comparing the use of these case studies in an experimental versus control class
- Use of paper-based versus multimedia case studies
- Impact of majors on use of multimedia case studies
- Impact of gender on use of multimedia case studies
- Impact of ethnic background on use of multimedia case studies

COMPARING THE USE OF THESE CASE STUDIES IN AN EXPERIMENTAL VERSUS CONTROL CLASS

An external evaluation team of researchers evaluated a course in which three case studies were used and compared the responses with a control group where the case studies were not used (Halpin, Halpin, and Good, 2000; Raju, et al., 2000a). The students in the case study class reported greater use of mapping, outlining, and planning; solving problems, reaching decisions, and making critical evaluations; and using other students within the class as a resource and as support systems.

The student journals that were completed for each case study demonstrated the use and development of higher order thinking skills - one of the course's primary objectives. Specifically, the students' comments in the journals indicated that they were engaging in sophisticated and complex levels of cognitive activity - defining, analyzing, evaluating reflecting, and assessing. The students not only employed these skills, but also applied these same skills to assess their own thinking processes, gaining valuable self-insights in the process. The student comments in their journals also indicated that they were making the necessary connections between the theories they studied and the practice they would assume in their analysis.

Perceived skill development, self-reported learning, and ability to learn from fellow students (all yielding medians of 3.9 or above on a 1 to 5 scale, with 1 being the worst and 5 being the best) were highly rated by the students. Another theme that occurred in the responses to the case study's strengths (approximately 1/5 of the responses) was the students' enhanced understanding and interest in technology.

The evaluators concluded, "The data from the various aspects of the evaluation indicated that the case study method of instruction is a worthwhile and beneficial method of instruction for teaching an engineering design course. The students in the case study course indicated their favorable responses to this particular teaching approach, and comparative data also suggested that the approach is particularly worthwhile and beneficial to the students. The case study method of instruction appeared to combine theory with practice as well as encourage the use of higher-order thinking skills within the students - the two primary goals of this particular class." (Halpin, Halpin and Good, 2000).

USE OF A PAPER-BASED VERSUS MULTIMEDIA CASE STUDY

An experiment was conducted in a computer lab where 39 students, divided into two groups, worked on a case study using either paper-based or multimedia based technologies (Mbarika et al., 2001, Raju and Sankar, 1999). The students were divided into teams and given two hours to read, analyze, and make presentations on a case study. Two questionnaires were administered to obtain feedback on their perceptions (Appendix III). An exploratory factor analysis design employing a structural equation model was used to analyze the data. The findings from

this study suggest a strong indirect relationship between multimedia and perceived skill development with learning-driven constructs (challenging, learning interest, self-reported learning, and learned from others) serving as the intervening variable. The study concluded that it is critical to consider these factors in developing multimedia instructional materials.

IMPACT OF MAJORS ON USE OF MULTIMEDIA CASE STUDY

Another research study was performed to investigate the perceptions of business versus engineering students regarding improvements in their higher-level cognitive skills as they participated in a multimedia based case study that depicted a complex engineering and technical problem (Mbarika et al., 2001). The case study provided the students with an opportunity to analyze the sensitivity of their recommendations using Expert Choice Software (Saaty, 1994). The same two questionnaires given in Appendix III solicited the perceptions of the students and a structural equation model was developed in order to analyze the information.

The results showed that the business students perceived a greater improvement in higher-order skills compared to engineering students. The results also showed that multimedia instructional materials were more effective for the students if the materials challenged the participants, provided self-learning opportunities, made it possible to learn from others, and enhanced learning interest.

IMPACT OF GENDER ON USE OF MULTIMEDIA CASE STUDY

Past research shows that female students tend to have more negative attitudes toward technology than male students (Busch, 1995; Levin & Gordon, 1989; Shashaani, 1994). These negative attitudes may explain the decreasing number of females pursuing technical careers. It is possible that changing the instructional materials might foster a change in the attitude of female students (Proost and Elen, 1997). Multimedia instructional materials were suggested as a possible solution. Therefore, we conducted a research study to investigate the perceptions of female versus male students regarding any improvements in their higher-level cognitive skills when they participated in a multimedia case study that used an expert system to model a complex engineering and technical problem.

The two questionnaires in Appendix III were used to measure their perceptions of the improvements achieved on learning and content constructs. A structural equations model was developed to analyze the results (Mbarika et al., 2001). The major findings were: female students perceived more improvement in their higher-order skills compared to male students, both groups perceived an improvement in the learning-driven factor, and female students valued learning-driven factors more highly than male students. These results show that multimedia instructional materials are likely to be helpful in teaching engineering and technical decisions to female students.

IMPACT OF ETHNIC BACKGROUND ON USE OF MULTIMEDIA CASE STUDY

Twenty three white students at Auburn University were given two separate evaluation questionnaires at the completion of a case study during Fall 1998 (Raju, et al., 2000). At the same time, 17 African-American students in a comparable class at Alabama A&M University were given the same questionnaires (Appendix III). Both sets of students were engineering majors. Neither set of students had previously worked with a multimedia case study. The responses from the students at Alabama A&M on the eight constructs were higher than the students from Auburn University.

The results show that the African American students responded very favorably to the multimedia case study methodology. In particular, the African American students perceived greater improvements in the constructs of “interesting and exciting,” “important and valuable,” “instructionally helpful,” “relevant and useful,” and “learn from fellow students.”

V. CONCLUSION

The research studies show that use of such multimedia case studies in undergraduate classrooms has the potential to provide enhanced opportunities for active learning and improvement in the higher-level cognitive skills of students. In addition, these case studies

stimulated interest in non-engineering, female, and minority students in engineering and technical topics.

Use of these materials in undergraduate courses at Auburn and other universities elicited positive comments. The multimedia case studies have proven effective in business and engineering classes, promoting students' ability to learn from one another and be challenged. The major limitations of these studies are that the sample size was small and the results were based on perceptions rather than on objective measures that quantify the improvement in learning of the students. Further research is needed that examines the impact of multimedia in other disciplines and larger populations.

ACKNOWLEDGEMENTS

The development of these educational materials was partially funded by the National Science Foundation, Division of Undergraduate Education, DUE #9752353 and 9950514. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF. Additional information is posted on the website: litee.auburn.edu. Funding opportunities are available from the NSF for adoption and implementation of these instructional materials in other universities.

Editor's Note: This article is based on the authors' workshop presented at AMCIS 2001. It was received on August 31, 2001 and was accepted on October 26, 2001. The article was with the authors for approximately 8 weeks for four revisions. This article was published on February 27, 2002 together with the other articles in the special issue on the AMCIS 2001 Workshops.

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APPENDIX I. SUMMARY OF CASE STUDIES

1. Chick-fil-A Case Study: This case study illustrates the decision faced by Chick-fil-A, a fast food chain, as it moves from its current Point-of-Sale system to a choice between two operating systems, one based on Windows NT and the other on Windows CE (Sankar and Raju, 2001). Since the Chick-fil-A chain operates over 700 stores, this changeover represents an approximately $3.2 million investment, due to the differences in costs between implementing the two POS systems. Concepts covered include: operating systems, central processing units, network design and layout, telecommunications, thin versus fat clients, system development cycles, project management, decision making, and cost/benefit analysis.
2. AUCNET USA Case Study: This case study describes the E-Commerce initiatives of a B-to-B company that sells automobiles to dealers using a satellite network (Sankar and Raju, 2001). The company is faced with decreasing dealer participation and needs to reexamine its IT architecture. Concepts covered include: Internet technology, geosynchronous satellites, low Earth orbiting satellites, on-line systems, proprietary systems, competition, new technologies, cost of technologies, marketing issues, entrepreneurship, cultural issues, and global issues.
3. Crist Power Plant Case Study: In this real-world case study students work with an expert system to refine their decision, choosing among multiple alternatives for maintaining a turbine-generator at a power plant (Sankar and Raju, 2001). The students assume the role of a plant manager in solving the $2 million problem. Concepts covered include: problem solving, preventive maintenance, phase relationships, risk management, decision support systems, project management, expert choice software, and deregulation.
4. Della Steam Plant Case Study: This case study examines the problem of a turbine-generator unit in a power plant that is vibrating heavily and shaking the building. Two engineers recommended conflicting solutions, and the plant manager must make a decision that could cost the company millions of dollars (Raju and Sankar, 2000a). Concepts covered include: problem solving, preventive maintenance, vibration, risk management, decision-making, credibility, cross-disciplinary issues, and active learning.
5. Design of Field Joint for STS 51-L Case Study: This case study shows the events leading to the decision to launch the space shuttle, STS 51-L. The case study provides the timelines and technical details concerning the design of the field joint (Raju and Sankar, 2000b).

Concepts covered include: physics and design, statistics, project management, ethics, risk, and safety.

6. In Hot Water: A Cooling Tower Case Study: This case study shows the decision facing the plant manager and engineers when they are faced with two alternative methods for improving the performance of a counterflow natural draft cooling tower. The source of the tower's underperformance appears to be the water distribution across the tower's area. The managers and engineers could either revert to an earlier configuration that was known to produce a tower efficiency of 91% or modify the tower based on a consultant's recommendation (Cochran, Raju, and Sankar, 2001). Concepts covered include: thermodynamics, waterflow, risk management, safety, and financial details.
7. Wireless Cell Tower Selection at Powertel Case Study: With the introduction of their new "3600 minutes for $40" rate plan, the growth of cellular subscribers jumped 40% in one month for Powertel. This growth put a tremendous strain on the existing cellular network structure. The number of dropped calls and unavailable lines increased significantly. One area of particular concern was the intersection of Highway 280 and Interstate 459 in Birmingham, AL. Powertel needed to decide quickly where and how to place an additional cell site to handle the new demand in that location. The two different choices presented for the cell site location will result in a financial impact in the range of $150,000 to $700,000 (Sankar and Raju, 2001). Concepts covered include: telecommunications, frequency reuse, project management, cell phone use, and time value of money.

APPENDIX II. SUPPORT MATERIAL FOR INSTRUCTORS

We offer a wealth of supplementary material in a CD-ROM that helps the instructors teach the material in each textbook. The CD-ROM includes:

- Instructor's Manual: The manual contains chapter overviews, teaching suggestions, team assignment questions, possible answers to questions that may arise in case study discussions, and a test bank of multiple-choice, short-answer, and essay questions.
- Videos: Videos supplement the presentation of the case studies so that the students can better understand the problem. This material could be played in class when the case studies are assigned.
- Powerpoint presentation package: This package contains most of the charts and photos from the textbook, making them easily accessible to the instructor for use in making the presentations in class.
- Suggestions for teaching: Suggestions to instructors are provided based on past research results. Forms that may be used to grade the course are also provided.
- Multiple-Choice and Essay Q&A: The questions at the end of each chapter are answered and multiple-choice questions have been created to help the instructor construct exams and tests.

APPENDIX III. QUESTIONNAIRES[1]

DESIGN OF CRIST CASE STUDY EVALUATION: I

Your completion of this rating scale will help us evaluate this Case Study. There are no right or wrong answers. Please be honest in your responses. Consider each set of bipolar descriptors (for example, challenging/not challenging) and circle from 1 to 5 the value which corresponds closest to your attitude regarding this case study.

1. Successful at Bringing Real-Life Problems to the session	1-------2-------3-------4-------5	Unsuccessful at Bringing Real-Life Problems to the session

[1] The same questionnaire was used with all the case studies. The name of the case study was changed as needed.

2. Challenging	1-------2-------3-------4-------5	Not Challenging
3. Clear	1-------2-------3-------4-------5	Unclear
4. Distant	1-------2-------3-------4-------5	Close
5. Dull	1-------2-------3-------4-------5	Lively
6. Easy to Comprehend	1-------2-------3-------4-------5	Difficult to Comprehend
7. Exciting	1-------2-------3-------4-------5	Boring
8. Helpful in Learning Difficult Concepts	1-------2-------3-------4-------5	Not Helpful in Learning Difficult Concepts
9. Dehumanizing	1-------2-------3-------4-------5	Humanizing
10. Important	1-------2-------3-------4-------5	Unimportant
11. Interesting	1-------2-------3-------4-------5	Uninteresting
12. Colorful	1-------2-------3-------4-------5	Ordinary
13. Meaningful	1-------2-------3-------4-------5	Meaningless
14. Emotional	1-------2-------3-------4-------5	Unemotional
15. Relevant	1-------2-------3-------4-------5	Irrelevant
16. Straightforward	1-------2-------3-------4-------5	Obscure
17. Personal	1-------2-------3-------4-------5	Impersonal
18. Helpful in Transferring Theory to Practice	1-------2-------3-------4-------5	Not Helpful in Transferring Theory to Practice
19. Useful	1-------2-------3-------4-------5	Useless
20. Cold	1-------2-------3-------4-------5	Warm
21. Well Organized	1-------2-------3-------4-------5	Poorly Organized
22. Routine	1-------2-------3-------4-------5	Extraordinary
23. Helpful in Providing a Sense of Accomplishment	1-------2-------3-------4-------5	Not Helpful in Providing a Sense of Accomplishment
24. Sensitive	1-------2-------3-------4-------5	Insensitive

CRIST CASE STUDY EVALUATION: II

Your responses to the following items will enable us to evaluate this case study. There are no right or wrong answers. Please respond to all items and be honest in your responses. Using the scale below, indicate the extent of your agreement/disagreement with each of the following items by circling 1 to 5.

a----------b----------c----------d----------e

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	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1.	I improved my ability to identify project management and decision-making issues.	a	b	c	d e
2.	I improved my ability to integrate project management and decision-making issues.	a	b	c	d e
3.	I improved my ability to evaluate critically project management and decision-making alternatives.	a	b	c	d e
4.	I became more confident in expressing my ideas.	a	b	c	d e
5.	I learned to value my colleagues' points of view.	a	b	c	d e
6.	I learned to interrelate important topics and ideas.	a	b	c	d e
7.	I improved my understanding of basic decision-making concepts.	a	b	c	d e
8.	I learned new concepts in engineering.	a	b	c	d e
9.	I learned to identify central project management and decision-making issues.	a	b	c	d e
10.	I discussed project management and decision-making outside of class.	a	b	c	d e
11.	I did additional reading on project management and decision-making topics.	a	b	c	d e
12.	I did some thinking for myself about project management and decision-making issues.	a	b	c	d e
13.	I learned to solve problems based on theories.	a	b	c	d e
14.	I improved my oral communication skills.	a	b	c	d e
15.	I improved my written communication skills.	a	b	c	d e
16.	I learned from other colleagues during the session.	a	b	c	d e
17.	I found connection between engineering concepts and the case study.	a	b	c	d e
18.	I identified various alternatives to the problem.	a	b	c	d e

What were the strengths of the Crist Case Study?

What were the weaknesses of the Crist Case Study?

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ABOUT THE AUTHORS

Chetan S. Sankar is the Thomas Walter Professor of Management at Auburn University, specializing in teaching telecommunications, IS Strategy, and Engineering management courses. He worked for many years in industry, including AT&T-Bell Laboratories. He published more than 100 articles in journals and in conference proceedings. He was selected as the outstanding researcher in the College of Business for 1997. Dr. Sankar is a winner of the 1990 Society for Information Management Paper Award Competition for outstanding work in the field of information systems and technology. He utilizes his research skills in order to improve the education of engineering and management students.

P.K. Raju is the Thomas Walter Professor of Technology Management & Director of Auburn Engineering Technical Assistance Program in the Mechanical Engineering Department at Auburn University. Dr. Raju has directed and managed a variety of sponsored research and development projects. These projects dealt with different aspects of acoustics, vibration, noise control, non-destructive evaluation, and engineering education. These projects were funded by industries, government, and international agencies, and total over $4.1 million. Dr. Raju authored or edited 18 books and published a total of 129 papers in journals and in conference proceedings. He received several awards for his teaching and research activities. He served as a United Nations expert during 1995-1996.

Drs. Sankar and Raju shared the 1997 Instructional Award for the Outstanding Paper in Engineering Education from the American Society for Engineering Education and the 1998 Curriculum Innovation Award from the American Society for Mechanical Engineers. They are also the joint recipients of the 1998 and 2001 Premier Award for Excellence in Engineering Education Courseware, sponsored by NEEDS and John Wiley and Sons. They are the editors-in-chief of the *Journal of SMET Education: Innovations and Research*. They received four National Science Foundation grants totaling $1.4 million to bring real-world issues into undergraduate classrooms. They are co-authors of eight books on engineering management published by Tavenner Publishers in 2000 and 2001.

Communications of the Association for Information Systems

ISSN: 1529-3181