Using Multimedia in an Engineering Economy Course

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ABSTRACT

This paper describes the use of computer-based multimedia course material in an engineering economy course taught at Virginia Tech. The interactive multimedia course material was developed over a period of two years and was used to support a National Science Foundation research project aimed at enhancing the undergraduate engineering curriculum through innovative application of design and economics principles.

1.0 Introduction

Interactive multimedia is fast becoming a useful platform for disseminating information in every aspect of society. Interactive multimedia can be defined as an information system that includes a combination of text, graphics, sound, video, and animation sequences packaged together to form an interactive visual/audio presentation of information and knowledge in which the end-user has a direct control on the flow of the presentation. Interactive multimedia can be used to support employee training, employ as a reference tool, provide powerful presentations, and use as a supplementary teaching tool in education [1, 2, 3].

Numerous innovative teaching methods have been used in the past but there is yet to be an optimal learning environment. However, it is generally accepted that if information is conveyed to students with a combination of text, color, graphics, animation, sound, moving pictures, and a degree of interactivity, the attention of the student will be significantly increased, promoting learning interest and enhancing retention of knowledge [5]. Studies have shown that people retain 25% of what they hear, 45% of what they see and hear, and almost 70% when they actively participate in the process [6]. Active participation is where the use of interactive multimedia lectures can become an important teaching aid.

This paper reports on the use of interactive multimedia instructional material in a classroom environment and describes the course material that was digitized into multimedia presentations. From written feedback given by students who were exposed to the multimedia instructional material, the overall consensus was that the use of interactive multimedia in the classroom has a positive effect on student's learning and interest towards the course.

2.0 The Multimedia Course Material

A series of multimedia-based lecture modules was developed in the Industrial and Systems Engineering Department at Virginia Tech [7]. These modules were used as instructional support material in Engineering Economy, a fundamental engineering course attended by all sophomore engineering students at Virginia Tech. The modules were developed to emphasize on important concepts of the course and they were meant to be shown in class at different stages of the course curriculum.

There are altogether eight modules, seven course modules and a control module (Figure 1). The control module enables the instructor to move back and forth from one course module to another. The modules consisted of animated and visual explanations on important concepts, with animated worked examples that are based on the sequential illustration of how engineering economic analysis can be applied to solve problems.

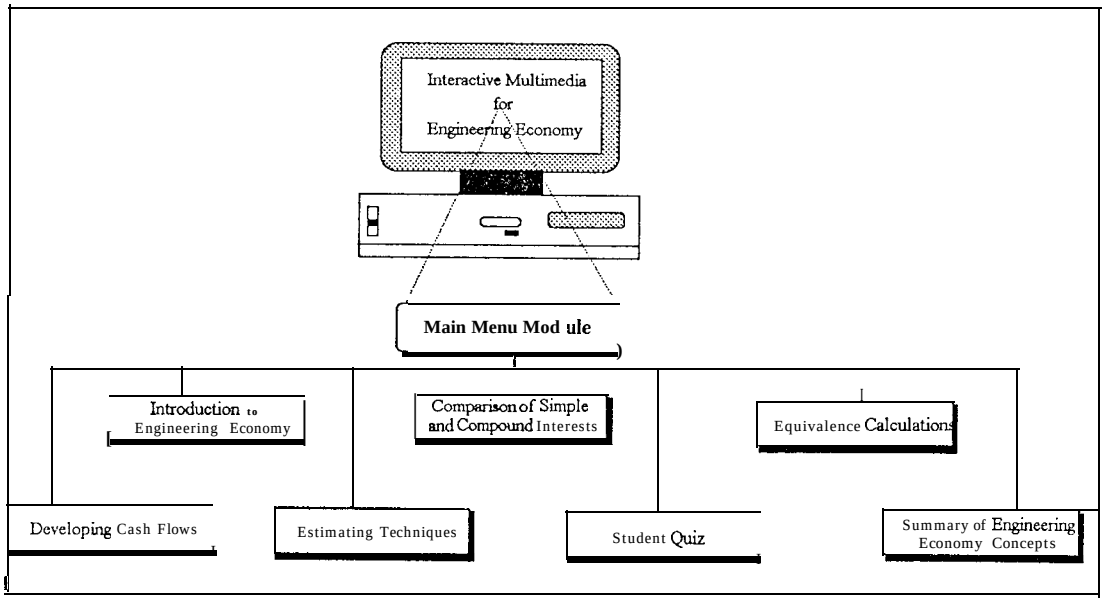

Figure 1: Engineering Economy Multimedia Modules

The following is a brief description of each of the interactive multimedia modules:

2.1 Control Module. The control module allows the instructor to provide an overview of engineering economy to the class. A brief video segment shows various applications of engineering economy in different industries. It also briefly describes the content in each of the seven course modules and provides navigation control to assess each of these seven course modules.

2.2 **Introduction to Engineering Economy.** This introductory module is used in the first two class periods of the course. It presents the basic objectives of the course. In this module, the use of engineering economy in relation to the principles of environmental conservation and design economics is illustrated. The purpose of this module is to educate students on the importance of engineering economy in engineering applications and let them have a sense of the overall perspective on how this discipline can be applied in many engineering projects.

2.3 **Comparison of Simple and Compound Interest.** This module looks at the difference between simple interest and compound interest. The module emphasizes the fundamental difference between using a simple interest and a compound interest rate for considering the value of money over an extended period of time (more than one year). In Figure 2, an animated graphical solution is presented for a hypothetical problem in which the difference in accumulated values (simple vs. compound interest) is projected over a period of years and the students can participate in choosing the correct answer to the problem.

2.4 Equivalence Calculations. This module looks at the principles and applications of money-time relationships in the context of equivalence calculations. The module takes the students through a series of

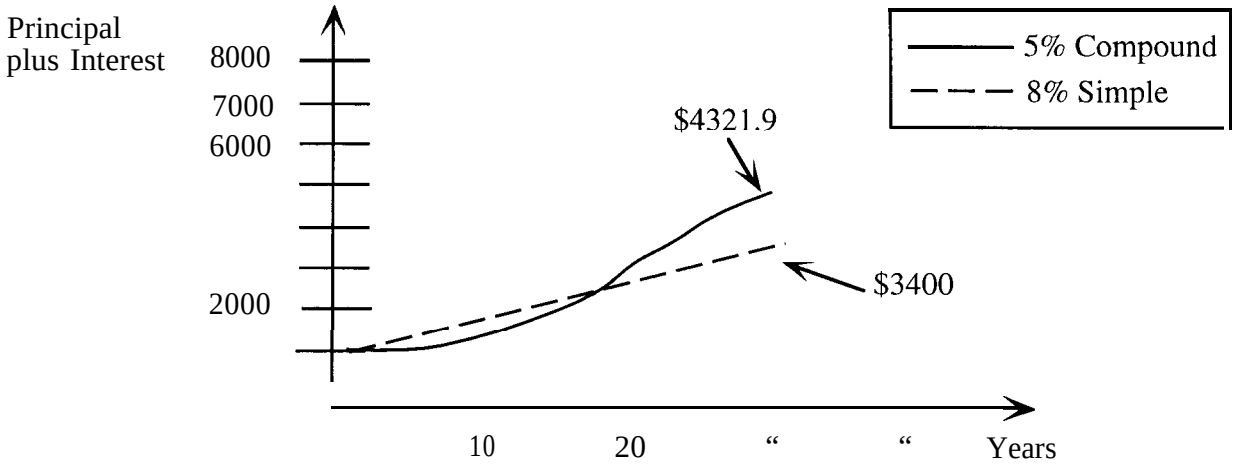

Figure 2: Animated Comparison Between Simple and Compound Interests

equivalence calculations using the various common interest factors found in engineering economy. For each factor, a problem is first posed to the student followed by animated visual presentation of the solution as well as step-by-step procedure for solving the problem.

2.5 **Developing Cash Flows.** This module introduces key concepts for developing cash flows for different alternatives under consideration. Within this module, animated illustrations were used to describe the use of cost and revenue categories, work breakdown structure, and sources of cost data for estimating cost. The objective here is to educate the students of the need for accurate cash flow projections to minimize uncertainty and improve economic decision-making.

2.6 **Estimating Techniques.** In this module, various estimating techniques used in engineering economy for projecting cash flows are illustrated as shown in Figure 3. Some of the primary techniques, such as indexes, unit technique, segmenting technique, factor technique, and power sizing are shown together with animated explanations. Worked examples to show the application of these techniques are embedded into this module.

2.7 **Student Quiz.** This module presents a quiz in which the user has the opportunity to gauge his/her understanding of major engineering economy concepts. The quiz consists of a set of multiple choice questions. For each question, the user selects one answer and the module will then use audio response to inform the user as to whether the selected answer is the correct choice. The user can also choose to look at the correct answer and its method of analysis.

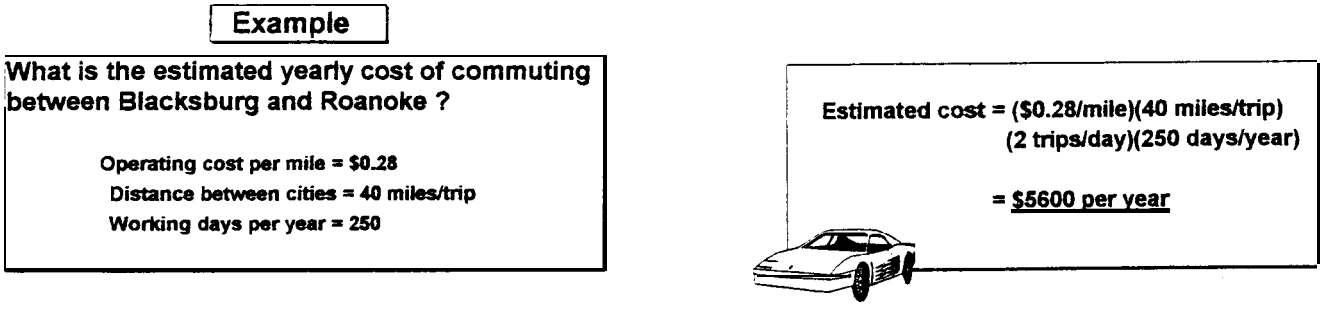

Figure 3: Cost Estimation Technique

2.8 Summary **of Engineering Economy Concepts.** This last module provides a summary of all the important fundamentals covered in the course. The building blocks of the course are emphasized in this module, and it provides a quick revision for the students in areas such as breakeven and sensitivity analysis, depreciation, forecasting, use of models, concept of equivalency, the engineering economic analysis procedure, and the economics of design.

3.0 Implementation in Classroom and **Its** Impact on Student's Learning

The multimedia-based lectures were shown in a large theater that seats about 300 students. The lectures were controlled from a PC and projected onto a wall screen via a big-screen projector. Each module in the series contained enough information to cover 50 minutes of lecture time,

The multimedia-based lectures were designed in a hypermedia format [4] that allows the instructor to control the flow of the presentation and navigate from one topic to another related topic while at the same time providing written explanations and eliciting responses from students.

The approach to the design of the multimedia-based lectures is based on a *"tutorial-style"* format whereby concepts and principles are first presented to the students. Next questions and multiple answers from which students can select are offered. Finally, as seen in Figure 4, explanations are given for the correct answers.

The interactive multimedia-based instructional material was demonstrated to students in the fall of 1993 and 1994. A survey was conducted at the end of the fall semester 1993 to gauge students' perspectives on the use of these multimedia support instructional material in the classroom. The overall assessment of the survey results indicated that this multimedia instructional material has a positive effect on reinforcing student's attention in the classroom and understanding of the course.

Part 5:

Imagine that you are now back at the end of 1984, with $500.26 in your pocket. If you were to deposit this amount into a bank that pays an annually compounded 8% interest rate, what will be the fixed annual withdrawal amount that you can make for the next nine years (from end-of-year 1985 to end-of-year 1993), exactly depleting your savings at the end of 1993?

Answer to Part 5:

Steps:

1 Use Uniform Series Capital Recovery Factor

❑ Find (A/P,i,N) at i=8% & N=9

3 A = $500.26 *(A/P,8%,9)
= $500.26* (0.1601)
= $80.09

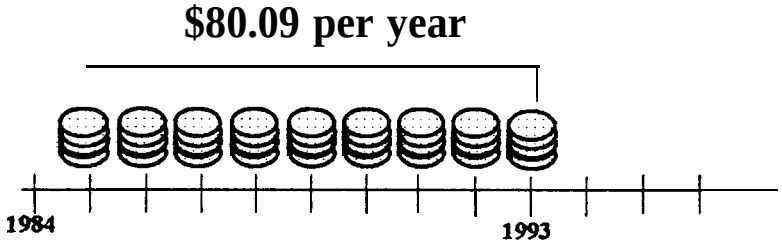

Figure 4: Animated Question/Answer Seauence

4.0 Summary and Conclusion

This paper has presented the use of interactive multimedia to enhance classroom instruction. The application of interactive multimedia in classroom provides a multisensory experience to the class, thereby giving the students added interest in class material. It also provides an interactive platform whereby students can reinforce their knowledge through personal participation.

The use of this mode of instruction is still in an early stage of experiment. However, this mode of instructional support has shown excellent potential in improving teaching methods as well as increasing student's interest and absorption rate of course material. It is an important educational issue that requires further development and research.

Acknowledgement

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References

[1] Luther, Arch C., Designing Interactive Multimedia, Batam Books, New York, 1992,

[2] Knee, Michael and Atkinsons, Steven D., Hypertext/Hypermedia: An Annotated Bibliography, Greenwood Publishing Group, Inc., Westport, Connecticut, 1990.

[3] Chen, Ching-chih, HyperSource on Multimedia/HyperMedia Technologies, American Library Association, USA, 1989.

[4] Hsi, Sherry and Agogino, Alice M., "The Impact and Instructional Benefit of Using Multimedia Case Studies to Teach Engineering Design," ASEE/IEEE Frontiers in Educational Conference, 1995.

[5] Hansen, E., "The Role of Interactive Video Technology in Higher Education: Case Study and Proposed Framework," Educational Technology, pp. 13-21, September 1990.

[6] Myers, D. K., "Interactive Video: A Chance to Plug the Literacy Leak," Industry Week, No. 239, pp. 15-18, April 1990.

[7] Lee, Pui-Mun and Sullivan, William G., Engineering Economy: A Tutorial on Essential Principles, CD-ROM format, 1994.

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