

SIMPLY SIMULATION: AN INTERACTIVE CD-ROM-BASED APPROACH FOR LEARNING SIMULATION CONCEPTS

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ABSTRACT

The purpose of this paper is to introduce a new approach to teaching an introductory simulation course using an interactive CD-ROM titled "Simply Simulation". This method utilizes several multimedia tools and a hypertext based web format. The simulation literature currently shows no studies on this proposed new teaching method. Course structure, requirements, and benefits of Simply Simulation are described in this paper. Simply Simulation gives detailed explanations on simulation concepts and easy-to-follow instructions in five modules. The student uses Taylor II process simulation software to model and analyze progressively more complex real life situations. Competencies gained are measured via a pretest at the beginning of each module and a quiz at the end of each module. This paper and Simply Simulation contribute to the simulation education literature by exemplifying how to enhance the learning effectiveness by utilizing various information technologies and teaching methods.

1 INTRODUCTION

The purpose of this paper is to introduce a new approach to teach an introductory simulation course, using an interactive CD-ROM titled "Simply Simulation". This method developed here utilizes several multimedia tools and a hypertext based web format. Various tools for effectively teaching an introductory simulation course effectively have been proposed in prior studies but no evidence in simulation literature shows an interactive CD-ROM based

introductory simulation course taught with multimedia and hypertext based web format. Such a lack of research drives the present study. This paper, therefore, attempts to fill the gap in the literature by proposing a new simulation teaching approach with Simply Simulation, an interactive multimedia hypertext based CD-ROM.

Course structure, requirements, and benefits of Simply Simulation are described in this paper. Simply Simulation gives detailed explanations on simulation concepts along with easy-to-follow instructions in five modules. This CD-ROM based course also features real-life applications of process simulation using Taylor II software. Simply Simulation is presented as an efficient and effective learning option for students in this research.

In the next section, prior studies are reported. Next the objectives of the authors are listed along with a list of the Baldrige National Quality Program 2000 Educational Criteria for Performance Excellence. The course structure and requirements of Simply Simulation are presented in Sections 4 and 5. The benefits of this new teaching approach follow. Section 6 concludes this paper.

2 LITERATURE REVIEW

Much research has reported on the effectiveness of new teaching approaches using various information technologies: First, interactive software is now being used frequently as a training tool. Fitzgerald (1999) argues that virtual training using interactive simulation software is effective in teaching mailroom operations.

Second, CD-ROMs have proven to be a convenient yet powerful medium to deliver large amounts of information. Conrad (1998) shows interactive CD-ROMs can be a productive tool to perform certain business functions such as achieving and maintaining the costly and time-consuming ISO9000 certification.

Third, multimedia presentation methods garner favorable responses from educators as well as students. They can make the material more interesting and facilitate the visualization of concepts and examples. Sung, Fadner, and Willis (1998) describe how multimedia enhances physics lab teaching. Supporting evidence is presented in an article in Mechanical Engineering in which an interactive CD-ROM-based multimedia approach enhances the effectiveness of learning mechanical-event simulation software (Anonymous 1998).

Finally, the Internet provides an exciting new medium that stimulates students to learn about concepts. Ng and Wong (1999) successfully use the Internet to teach statistics. As a result, Simply Simulation, an interactive CD-ROM-based multimedia course using the web format is proposed in this paper to help students learn the simulation concepts.

3 OBJECTIVES

The authors began this activity out of a desire to make simulation education more accessible to a broader audience including our own undergraduate business students. Here we apply Baldrige Quality 2000 Education Criteria to teaching an introductory class in process simulation to undergraduate business students. The collection of learning materials, exercises, activities and quizzes enables the student to construct models, discover theory and problem solve. It also provides for the evaluation of competencies and the assessment of the student's skills.

The Baldrige National Quality Program 2000 Educational Criteria for Performance Excellence describes the following key characteristics of learning-centered education:

- setting high developmental expectations and standards for all students.
- understanding that students may learn in different ways and at different rates.
- providing a primary emphasis on active learning. This may require the use of a wide range of techniques, materials, and experiences to engage student interest.
- using formative assessment to measure learning early in the learning process and to tailor learning experiences to individual needs and learning styles.
- using summative assessment to measure progress against key, relevant external standards and norms regarding what students should know and be able to do.

- assisting students and families to use self-assessment to chart progress and to clarify goals and gaps; and focusing on key transitions such as school-to-school and school-to-work.

Our work to date has focused on the third, fourth and fifth point(s). Future enhancements will strengthen our application of the other points. In addition to our desire to create an active learning environment according to the criteria outlined above our motivations and objectives were:

- to create a powerful and enjoyable educational tool.
- to make it easy for students to learn about and use simulation as a problem solving tool.
- to use technology and simulation software to stimulate curiosity, increase understanding and improve intuition by actively observing and evaluating visual information.
- to incorporate learning activities which would have broad appeal to a variety of students.
- to include enough diversity in activities that the visual learner as well as the oral learner would have a path to understanding.
- to promote the realistic and practical side of simulation to a population previously neglected.

Our intent is to establish an integrated approach to such diverse topics as probability distributions, statistics and queuing theory in the context of learning about simulation as problem solving tool. Our CD-ROM presentation and the approach developed here allow the student to control the pace and content of their exposure to new material.

4 COURSE STRUCTURE

Simply Simulation begins with a hypertext syllabus, and covers the fundamentals of simulation concepts, quizzes, exercises, and skill building assignments. This CD-based course also features several real-life application in which the process simulation software Taylor II is employed by the student to build and run animated simulation. The modules of Simply Simulation are listed in Table 1:

Table 1: Table of Contents

Introduction to Simply Simulation
Syllabus
What is simulation?
Advantages of Simulation
Disadvantages of Simulation
Uses of Simulation
Module One – Independent and Dependent Systems
Module Two – Series and Parallel Systems
Module Three – Product and Service Variability
Module Four – Deming's Profound Knowledge
Module Five – Systems Dynamics

Each of the five modules contains a suggested learning path similar to the learning path shown in Table 2 for Module 2.

Table 2: The Contents of Learning Module 2

		Module Two: Series and Parallel Systems
Learning Path		
1	Take the Pretest	
2	Read the Learning Objectives	
3	View the PowerPoint Narrative	
4	Observe the Ice Cream Sundae Model	
5	View the Tutorial	
6	Do the Skill-Building Assignments	
7	Add to the Progressive Model	
8	Review These Terms	
	Queue	Normal Distribution
	Server	Empirical Data
	Discrete Values	Series System
	Waiting Line	Parallel System
	Inter-arrival Time	
9	Read related information	
10	Take Quiz Test	

5 COURSE REQUIREMENTS

The prerequisites for this CD based course are minimal in order to appeal to a broad audience. Students are expected to have studied only introductory statistics prior to this course. Simply Simulation is designed as a two quarter-credit class and there are five modules included in the CD. This course can serve as an elective class in the business or industrial engineering curricula at the undergraduate as well as the MBA level.

Simply Simulation requires only one CD in which the course information is stored. All files are presented in hypertext accessible format. Students use a web browser (such as Internet Explorer or Netscape) to access, view and work through the course materials. The material is primarily presented in terms of web pages, Microsoft PowerPoint presentations with narration (sound effects) or screen camera video captures. A recordable CD costs about \$1.50 and it takes about 10 minutes to burn each CD with approximately 300 megabytes for Simply Simulation. Student or lab computers are expected to be equipped with multimedia functionality to get the most out of this CD. To run Simply Simulation effectively, the following system requirements are suggested: IBM PC compatible with 16 meg of RAM, 20 meg of HD space available, Windows 95 or above, CD-ROM drive, multimedia capability, SVGA (800x600) or above, MS-Office Suite, and Netscape Navigator or Internet Explorer.

6 COURSE BENEFITS

Simply Simulation gives tremendous convenience, efficiency and flexibility to students: First, the CD-ROM format allows the student to learn when the Internet may not be available. Also, the CD medium reduces wasted time in several ways: It can be updated more quickly than a textbook. CD-ROM based materials may be accessed much more quickly than over the internet therefore files can be larger and more comprehensive.

Second, students can easily navigate the vast amount of information on the CD via a web browser. The hypertext format lends itself to the advantages of self-paced learning. The students get just the amount of definition that they need to continue with the course. Students get access to more in depth explanations via hypertext links whereas they do not have to access the hypertext material if they do not need further explanation.

Third, interactive capacity incorporating volatile web based material such as quizzes, instant grading, etc. could be seamlessly blended with the static high-bandwidth material delivered via CD-ROM.

The CD-ROM presentation is a flexible as well as efficient learning environment. Faculty can choose to use the CD-ROM to cover all simulation topics (as an independent study course) or as a supplement to the traditional classroom materials. Obviously the student still needs to learn the subject regardless of the form of presentation. The beauty of using the CD-ROM is that students have review resources as well as current course materials at one time and one location. Since the student has control of their own learning environment, they are empowered to determine the time, order, and to a lesser degree, the method of learning simulation concepts.

7 SUMMARY AND CONCLUSION

In summary, this paper describes Simply Simulation, a CD-ROM based introductory simulation course with a new teaching approach. Simply Simulation can be used as a stand-alone independent-study course or as supplementary material for the introductory simulation course if a traditional textbook is adopted. Simply Simulation complements traditional classroom lecture presentations in various ways.

In addition to simulation, a multimedia CD-ROM based course can apply to other fields in Operations Research/Management Science (OR/MS). Further studies also may explore the possibility that developing a web-based course that will appeal to a broader audience and may enhance the interaction between instructor and student. More interactive features can be added in future research.

In conclusion, this paper presents simulation educators with additional perspectives, methods and materials to teach an introductory simulation course. This paper and

Simply Simulation contribute to the simulation education literature by exemplifying how to enhance the learning effectiveness by utilizing various information technologies and teaching methods.

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REFERENCES

- Anonymous. 1998. Online Resources. *Mechanical Engineering* 120(5) 18.
- Baldrige National Quality Program, 2000 Education Criteria for Performance Excellence <<http://www.quality.nist.gov>>.
- Conrad, A. 1998. Software simplifies ISO9000 certification. *Microwaves & RF* 37(10) 150.
- Fitzerald, M. 1999. *Virtual Training: Computer Tutorial on Mailroom Operations*. Editor & Publisher 132(4) 32.
- Ng, V. M. and Y. Wong. 1999. Using simulation on the Internet to teach statistics. *The Mathematics Teacher* 92(8) 729-733.
- Nordgren, B. 1994. Taylor II manufacturing simulation software. In *Proceedings of 1994 Winter Simulation Conference*, eds. J.D. Tew, M.S. Manivannan, D.A. Sadowski, and A.F. Seila, 446-449, Association for Computing Machinery, New York, NY.
- Seila, A. 1995. Introduction to Simulation. In *Proceedings of 1995 Winter Simulation Conference*, eds. C. Alexopoulos, K. Kang, W. R. Lilegdon, and D. Goldsman, Institute of Electrical Engineers, Piscataway, New Jersey.
- Sung, R., W. Fadner, and C. Willis. 1998. Computer-enhanced physics laboratories. *Computers in Physics* 12 (2) 133-7.

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