Best Practices in High-Tech Learning

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Best Practices in High-Tech Learning

Abstract
The Synthesis Coalition, one of the first two engineering coalitions funded by the National Science Foundation in 1990, is comprised of Berkeley, Cal Poly at San Luis Obispo, Cornell, Hampton, Iowa State, Southern, Stanford, and Tuskegee. One of the major goals of the coalition was to create the National Engineering Educational Delivery System (NEEDS). This system consists of a multimedia, indexed database where engineering lessons, modules and images are stored for retrieval, courseware studios to create and modify multimedia courseware, and high-technology delivery systems (learning environments) for appropriate display of the material [1-3].

Disciplines
Engineering Education | Other Materials Science and Engineering | Science and Mathematics Education

Comments
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1.0 Introduction

The Synthesis Coalition, one of the first two engineering coalitions funded by the National Science Foundation in 1990, is comprised of Berkeley, Cal Poly at San Luis Obispo, Cornell, Hampton, Iowa State, Southern, Stanford, and Tuskegee. One of the major goals of the coalition was to create the National Engineering Educational Delivery System (NEEDS). This system consists of a multimedia, indexed database where engineering lessons, modules and images are stored for retrieval, courseware studios to create and modify multimedia courseware, and high-technology delivery systems (learning environments) for appropriate display of the material [1-3].

One area which has seen a great deal of growth in recent years, both in and outside of the Synthesis Coalition, is in the use of high-technology in the classroom [4-6]. In fact, an electronic newsletter run by Karen McBride at the University of Colorado is a monthly update on current uses of information technology on college campuses, including high-technology classrooms. With experiences, both successes and failures, in using such classrooms being shared for the common good and the burgeoning use of the world wide web coming into vogue, the Synthesis Coalition decided to create an electronic document on the www [7]. This is seen as a living document where interested parties can read (and view) others experiences and contribute their own experiences to update the Best Practices Document.

2.0 The Best Practices Document

2.1 Introduction

Recently introduced high-technology teaching aids, particularly those involving computers, have been only modestly used by teachers thus far. The reason for this is that most teachers do not see the advantages of using high-tech tools in the educational environment. Many of those who see the value of these tools have trouble integrating them into their teaching strategy. Motivated by the belief that these tools can be very helpful in the learning environment, we have developed a World Wide Web based multimedia document, Best Practices, which has been designed to educate and inform teachers on how best to use the technology. It is comprised of the observations of instructors, teaching assistants, and students. It also contains results from student and instructor questionnaires, as well as examples of ways that high-tech has been used at U.C. Berkeley and other schools. It is a working project, subject to continual updating, restructuring, and addition of new material. The URL (Uniform Resource Locator) is

http://bishop.berkeley.edu/Best_Practices/best.html

2.2 Multimedia and Hypermedia

Multimedia is a very effective tool for communication. Video, sound, animation, pictures, graphics, and text are interwoven into a computer-based presentation. The Best Practices document contains each of these types of elements. Quicktime movies of lectures and interviews, animations of computer courseware, pictures of equipment and relevant people, and graphics showing survey results are included. The text is the carrier, the glue that holds the elements together. Hypermedia allows for user-controlled navigation. The document contains links which, when used, connect the user to different information. This way the user may review only the material that is of particular interest to him or her, provided, of course, that the navigational system and interface are easy to use.
2.3 World Wide Web

*Best Practices* is part of the World Wide Web (WWW). The WWW is a platform-independent network of information accessible through a graphical interface, through which users can download text, images, video, and sound from remote locations. Most items on the web are accessible to all users. *Best Practices* will be linked to the NEEDS database, among other web locations. Each page in the document is an HTML (hypertext markup language) file. A web browser, which is located on the user's machine, reads HTML files and produces web pages for the user. HTML allows for many hypermedia possibilities, which are realized in *Best Practices*. Text-links and image-links are contained within the document. Each link sends the user to another page in the document, or perhaps even to a different location in the current page. The user can even be sent to HTML pages outside *Best Practices*, on other file servers on the WWW. Obviously, the user can navigate through the document in a non-linear fashion.

2.4 Content Overview

*Best Practices* is organized as shown in the Main Menu, shown in Figure 1. Material is divided into two groups: Computer-Supported Lectures and Project-Based Learning. Both groups contain logistical information: The Lectures section addresses lighting concerns and has an equipment overview. Project-Based Learning discusses the elements of the computer laboratory. It is our firm belief that teachers must understand the logistics of equipment usage if they wish to optimize their benefits in the learning environment.

Both groups also contain specific examples of ways that high-tech tools have been used in undergraduate engineering courses. The Lectures group presents overviews of two undergraduate engineering courses taught at U.C. Berkeley, "Instrumentation and Measurement" (ME107A) and "Graphical Communication in Engineering" (E28). These two courses are also discussed in the Projects group. It is the hope of the authors that these specific examples will inspire teachers and open the door to possibilities they might not have been aware of.

2.5 Computer Supported Lectures

A discussion of lighting problems encountered during computer projection is highlighted by the recommendation to use incandescent dimmable downlights (see Figure 2). The use of track lights is also encouraged. The ensuing equipment overview discusses the computer, computer projection methods, and lecture environments. The computer is identified as the most important high-tech learning tool, and the other sections are mostly concerned with ways that it can be integrated into lectures. The discussion of computer projection involves the LCD panel and the RGB projection system. Quicktime movies show examples of how LCD panels and RGB display systems are used. Faculty and staff are interviewed, and they explain the advantages and disadvantages of each projection style. Additionally, we discuss the virtues of classrooms that are specially equipped with video cameras and distributed monitors.

![Figure 1. Best Practices Main Menu.](http://bishop.berkeley.edu/Best_Practices/main.html)
2.6 Project-Based Learning

First, there is a brief discussion of issues involved with the computer laboratory, dealing with labroom design, networking, air-conditioning, concurrent projection, and the "shared screens" feature. The remainder of Best Practices deals with three specific class projects and activities: the ME107A laboratory tutorials, the E28 Color Spin lab, and the E28 Spatial Reasoning Workshop.

2.7 ME107A Laboratory Tutorials

In ME107A, computer-based laboratory tutorials were used to help students prepare for lab assignments. Each tutorial was developed for a specific lab assignment, and students reviewed the tutorials before each lab session. The advantage of the tutorials is the multimedia interface, which allows students to see pictures and view movies to help them visualize and understand class material. Best Practices explains the tutorials' navigational system, showing screenshots from the Vibrations Tutorial. A student survey indicated that most of the students found the tutorials easy to navigate, and didn't end up getting lost. It also revealed that most of the students prefer moving through the tutorials linearly at first.

2.8 E28 Mattel Color Spin Lab

The E28 Mattel Color Spin Lab was designed to integrate computer-based courseware with hands-on activity. The color spin is a small toy which the class used in studying mechanical dissection. Students spent half their time physically examining the toy, and the other half viewing a design case study created for it. The examination allowed them to take it apart, and they were also given a questionnaire concerned with design considerations. The case study contains interviews of Mattel employees, as well as

The implementation of courseware into the lecture environment is shown in the examination of ME107A and E28. The treatment of ME107A, "Instrumentation and Measurement", exposes one of the potential pitfalls of using high-technology during lectures. Students indicate a preference for blackboard-based lectures, due to the contention that the pace of the computer-based lectures was too fast. The instructor also shared this opinion. The students greatly approved of the practice of offering them access to computer-based lecture courseware, so that they can review it at their own convenience. Finally, the section concludes with a brief discussion of lecture courseware preparation time. The instructor of ME107A spent approximately six to eight hours in preparation for each hour and a half lecture.

The discussion of E28, "Graphical Communication in Engineering", addresses some of the lessons learned from ME107A. Specifically, the pace was slowed down. Students indicated a general approval of the computer-based style. Most of them indicated the pace to be "Just right". Some even described it to be slower than necessary. Again, the students approved of being given access to the course lecture notes.
Examination of the Color Spin

The students were given the opportunity to learn about the Color Spin. They could hold it, shake it, tilt it, take it apart, and put it back together. They were also given a questionnaire concerned with the design number of parts, production process, safety features, etc (I.S. Tan Professor Agustino).

The Case Study

Hopefully, most of the students' questions about the Color Spin computer-based case study. The case study contains interviews, production video taken from inside the plant. It shows the new design, the old one, and the associated advantages and disadvantages. The case study is both getting students more interested in the material.

Figure 3. Excerpt from the Color Spin section.

production video taken from inside the plant. It shows the new design, the old one, and the associated advantages and disadvantages. The case study is both getting students more interested in the material. Figures 3 and 4 show an excerpt from the section of Best Practices which deals with the color spin.

Figure 4. The same page as in Figure 3, after one of the quicktime movies has been downloaded.

2.9 E28 Spatial Reasoning Workshop

The E28 Spatial Reasoning Workshop was held to help students improve their spatial reasoning skills, and consisted of various exercises. Two of these exercises were computer-based software applications, BLOCKSTACKING™ and DISPLAY OBJECT™. Best Practices focuses primarily on the use of these software applications. First, there are some video excerpts from the workshop, showing students using the computers. Second, both applications are explained and demonstrated. Third, the results of a student questionnaire are discussed. The students are asked questions such as "Did this session help or hurt your ability to reason spatially?" and "How has your level of confidence in spatial reasoning changed as a result of this session?", to which most of them responded positively. Finally, the document contains some video excerpts of student interviews. Here, the students focus on issues such as whether the workshop was enjoyable, what might have troubled them, and whether it was better than conventional styles of learning. Those interviewed expressed that learning...
from a computer-based platform was more enjoyable, motivating, and effective than other styles, primarily because it is interactive and allows for better 3-D visualization.

3.0 Future Directions

There are several directions which are being pursued for improvements. We would like to create a bulletin board where interested readers could post comments and suggestions as well as indicate their interest in contributing to the document itself. The number and types of use of high-technology delivery systems is growing and the document will need to be expanded to cover the various uses in these new areas. The development of courseware that is used in multimedia lessons is also fertile ground for sharing experiences in the "Best Practices" concept. Another future direction might be to discuss the uses of the internet, and specifically the world wide web, in educational environments.

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Lawrence J. Genalo obtained the B.A. degree from Hofstra University in 1971, and the M.S. and Ph.D. degrees from Iowa State University in 1974 and 1977, respectively. His Ph.D. is in Applied Mathematics with an emphasis in Systems Engineering. He has been at Iowa State University since 1971, and has been an Associate Professor since 1981. He has served ASEE as Program and Division Chair for Freshman Programs and DELOS. His current research interest is in bringing high-technology classroom delivery systems into greater use in engineering education through his work with the NSF-funded Synthesis Coalition.