Lecturing with a Notebook Computer*

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Computers and related publishing and presentation technologies of ever increasing sophistication are available for use in the classroom. Nevertheless, most classes still are taught using the time-honored chalkboard. Reasons for this are explored and a notebook computer solution is described.

INTRODUCTION

WHEN Radio Shack, Apple, and Commodore introduced affordable personal computers two decades ago no one could envision the incredible proliferation of computers and related equipment. Numerous publishing and display technologies have been developed that can be employed effectively in the classroom. In spite of this, chalk and blackboard remain the visual aid of choice in all too many classes. In fact the most widespread change is in the board itself. Colors other than black have become popular and white dry erase boards are being installed in many buildings.

One must question why more advantage is not taken of technology in the classroom. Clearly the need is there. With the amount of information expanding at an ever-increasing rate anything that could be done to make classroom teaching and learning more efficient certainly would be welcome. The objective should be to cover more material while enhancing comprehension. Techniques must be developed to take advantage of technology in not only increasing coverage, but in making the students active participants in the class and thereby increasing comprehension and retention of knowledge.

OBSTACLES TO EMPLOYING TECHNOLOGY

In searching for methods of increasing learning efficiency in the classroom, one must first identify the obstacles to employing technology. One obvious culprit is inertia on the part of the faculty. Some instructors just do not wish to exert the effort necessary to institute changes. In such instances administrative action is required to prod reluctant faculty into action. Before this is done, care must be taken to see that an appropriate environment has been provided.

An appropriate environment refers to both facilities and the availability of equipment. The principal concern with respect to facilities is the classroom. Classrooms should provide a good quality screen and a dry erase board plus secure storage for equipment. Availability of equipment involves not only ownership; but also, availability in the classroom. Any instructor who must transport a computer, overhead projector, and display panel to an upper floor in another building is likely to revert to chalk and blackboard.

Lack of time and funds often is a significant obstacle to integration of technology into the classroom. The administration can take the initiative here by providing release time to faculty members, funds to hire graduate students, and funds for supplies and equipment. Alternately this can be viewed as a faculty responsibility. In this case it is expected that professors write proposals to obtain external support.

Another issue is reluctance on the part of instructors to employ new methods because of skepticism concerning their effectiveness. For example merely projecting lecture notes, whether it be via transparencies or a computer display, is likely to lose student interest in short order. The glare and fan noise of an overhead projector or balky slide projector are distractions. Student reaction also can be a concern. Like faculty, some students resist change and thus would have a negative reaction, even to effective use of technology.

ACHIEVING THE OBJECTIVE

It already has been noted that the objective of employing technology in the classroom should be to increase learning efficiency, i.e. to increase coverage while improving comprehension. One paradigm is to equip lecture halls and auditoriums with the latest sophisticated multimedia systems [1, 2]. Sound, graphics, animation, text, and video from CD-ROM drives would be available to greatly enhance presentations. These presentations would be for large classes and for lecture classes that are serviced by small recitation sections.

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The difficulty with this paradigm is that it is costly and reaches only a limited audience. The cost consists of both time and money. To take full advantage of the multimedia, an inordinate amount of time would be required to prepare the lectures and to learn how to operate the equipment. Furthermore, a considerable amount of time is required to set up and take down the equipment, usually more than the interval between classes. While large classes and lectures would benefit from this effort, other classes would be excluded.

Therefore, to achieve the objective of increasing learning efficiency, a system is required that is both cost and time effective and is universally available to all classes. Costs can be kept to a minimum by designing a low cost system that can be transported easily to any classroom. As an alternative these systems could be stored in strategic locations accessible from the classrooms. Time can be spent most profitably by adapting lectures to the system. This is preferred to preparing pretentious presentations that might do more to showcase the technology than to meet educational goals.

A NOTEBOOK COMPUTER-BASED SYSTEM

A system that meets the above objective consists of a notebook computer and a combination overhead projector-display panel [3]. The use of the combination unit, rather than an overhead projector and a separate display panel, means that only two pieces of equipment need be transported to the classroom. If necessary, they can be carried in an airline suitcase with wheels and a built-in handle.

The computer should have sufficient hard disk space to hold Windows, a word processor such as Microsoft Word for Windows, lecture notes that contain a significant amount of graphics, and applications software for the course. The processor should be fast enough to accommodate rapid changes from one complex diagram to another. The computer should be compatible with the display panel and should allow for simultaneous viewing of the projected image and the image on the computer screen.

While a color display panel is desirable, a quality black and white unit will suffice if cost is an issue. In either case it is important that sufficient time be allocated for adjustments before class. For the panel itself this means positioning the unit as well as configuring the controls. Careful attention also should be given to the computer display. For example, it was found that changing to enlarged bold-faced Arial fonts from standard Courier resulted in considerable improvement in the quality of the projected image.

Except for the projection surface this system can be used in any classroom. The projection surface can be a standard screen or a dry erase board. The dry erase board is not quite as clear as a screen and suffers from glare at some angles. It has the advantage, however, that images can be annotated. In addition, dry erase boards with a matte finish for glare reduction are becoming available. Substitutes for dry erase boards can be found. These include lightweight boards that can be propped against a chalkboard and plastic sheets that adhere by static cling.

This system has been successfully employed in an undergraduate electrical engineering course in microprocessors using the Motorola HC11. Work-study students, who were operators for a UNIX system, were asked to enter the text of the lectures for the course into the system. The author then converted this text to Microsoft Word for Windows 6.0 [4] with appropriate formatting. Simple diagrams and tables were constructed using Word. Complex figures from the manufacturers' manuals were scanned and imported into the Word files. Lectures were projected using Word rather than a hypertext facility [5]. Word was used to avoid getting involved with another software package. In addition, Word has a full range of display options including single and multiple line scrolling, jump to a specified page, full screen display, split screen display, and change of fonts.

PEDAGOGICAL CONSIDERATIONS

The above system provides for displaying lecture notes for any class, large or small. One must ask, however, is it realistic to have students sit passively as notes scroll by? Clearly the answer is no. As a minimum the students must be given ample time to copy the notes. From an educational standpoint copying notes is counterproductive. It is a throwback to the traditional lecture system where the professor writes and the students copy, except now the professor displays rather than writes. Either way the students are busy copying and there is little opportunity for comprehension. Since the notes are in electronic form, an obvious solution is to make them available to the students. This was done in the microprocessor course, first by distributing notes in class and later by placing them on sale in the campus store.

While this arrangement would appear to have solved the problem of students attempting to copy and comprehend simultaneously, it could in fact have had a negative impact on the learning process. Consider student reaction to what would have amounted to a hi-tech scroll through the classnotes. In its own way the old lecture system kept the students engaged by having them take notes. Furthermore, writing by both the students and the instructor inserted a time lag in which information could be absorbed.

On the basis of these observations it was decided to employ a technique called semi-notes [6]. Semi-notes are lecture notes where the structure, lengthy text, complex equations, complicated diagrams and tables, and computer programs are retained,

but significant portions are omitted. The omitted portions are completed in class. This provides an incentive for students to maintain attention and to customize their notes, while freeing them of tedious copying. The process was facilitated by displaying and annotating the notes on a dry erase board.

An important issue in constructing semi-notes is which portions of the notes to withhold. One technique is to arbitrarily select portions for omission. This has the advantage that what has been left out is obvious to students in class as well as those who are attempting to make up an absence. The disadvantage is that it is contrived and takes a good set of lecture notes and reduces them to a Swiss cheese-like document.

A preferred approach is to rewrite the lecture notes in semi-notes form. This provides for a smooth flow of material, but with numerous places where explanations require elaboration. Included can be anything from a brief clarifying remark to a complete discussion. In each instance sufficient space should be left for insertion of additional material.

The semi-notes technique not only encourages students to maintain attention; but also, provides an opportunity for them to become active participants in the class. Brief remarks should be inserted in response to student comments. Explanations presented by the instructor merely are a variation of the old lecture system. Instead, students should assist in the formulation of explanations. This includes permitting alternatives to what the instructor has in mind, even if revisions are required as the discussion progresses.

Semi-notes can be a vehicle for reforming the lecture system. While many instructors are reluctant to completely abandon lectures as a mode of teaching, they might be willing to try semi-notes as a compromise between the oral and visual learner. During discussions, the instructor has numerous opportunities to reinforce comments made by students. On the other hand visual learners who prefer a set of notes for further study, leave class with a better set of notes than they would under the traditional lecture system.

Discussion of assembly language programs provided some interesting opportunities for employing pedagogical strategies. Complete programs were presented without any comments, with comments being added in class. The full screen view in Word permitted most programs to be displayed in their entirety. When this was not possible, the split screen view allowed related segments of the code to be displayed and provided for scrolling through these segments. A cross-assembler and simulator for the HC11 permitted classroom demonstrations of the processing of programs. Because of the large number of programs, this was done only in selected cases. For example, processing for the macro facility was graphically illustrated in this manner.

CONCLUSIONS

The employment of display and publishing technology has been successfully employed to reform the lecture system and thereby improve the efficiency of the learning process. A notebook computer-based system has made it possible to extend this reform to all classes, large and small. It has been found that carefully considered pedagogical strategies must be applied in order to make this scheme effective.

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