A COMPREHENSIVE EVALUATION MODEL FOR COMPUTER BASED EDUCATION

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ABSTRACT

As opportunities to use computers in learning laboratory settings increase, directors will be faced with the problem of assisting faculty to select and evaluate the most appropriate courseware for their needs. This article presents a comprehensive evaluation model that could be applied for computer based education programs in a variety of arts and sciences areas. The model includes a pre-implementation stage. This stage determines program compatibility, content evaluation and hardware considerations. A second stage considers formative evaluation, continued availability of equipment and the recording of time records. Finally, the last phase, summative evaluation, includes collecting student attitudes, assessing cost effectiveness, determining external influences and finally, suggesting ways of reaching a decision of worth. The implementation of this model should provide a system where students could work with computer programs of a proven quality. Also, learning laboratory directors and faculty could show a certain level of accountability towards spending money on computer software or courseware.
Key Words: Computer, computer assisted instruction (CAI), computer based education (CBE), language laboratory, learning laboratory, evaluation.

Computer technology has had a very persuasive impact on educational settings in various areas throughout education in recent years. For many astute educators, there is no doubt that it can be a potentially powerful and effective tool for instruction. With the advent of the microcomputer, computer applications have become extremely cost-effective and within the reach of many school systems. Within the near future, the quantity of educational courseware will greatly expand. These materials will range from the very simple to the extremely complex and sophisticated. They may also vary in their level of effectiveness. Generally, present findings have indicated that most commercially produced courseware already on the market does not fully utilize instructional strategies which facilitate conceptional learning (Cohen, 1982). To this date, no universally accepted criteria for evaluating computer assisted materials have been adapted.

Each set of materials needs an evaluation plan. This is particularly important if the program is new to the school system or if the program is to be purchased, as is the case with many computer based education (CBE) programs. A multiple approach evaluation

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should be conducted (Hazen, 1980). The value of any material should be evaluated using more than one approach before the course has been completed.

Scriven describes two stages of evaluation, the formative evaluation, an assessment of the program as it is being implemented, and the summative evaluation, an assessment of the program after it has been completed (Scriven, 1973). When evaluating CBE, another stage should also be included. The pre-implementation stage should be designed to assess the content of the program, the design of the instruction, and the hardware and software requirements of the program. The evaluation plan should contain the procedures to be used for each of these processes.

A review of the literature has shown that there is a great deal written about evaluating the text of CBE programs for possible purchase, comparing the course outcomes of students participating in CBE programs with their counterparts receiving instruction in the same course content in traditional settings (classroom lectures), and evaluating the cost-effectiveness of implementation. In spite of all this information, there appears to be little written which correlates these concepts into one useful unified model.

The purpose of this article is to present a possible evaluation plan which may be implemented when evaluating CBE based programs. In order to view this model as one evaluation strategy, it is important to keep in mind that the ideas presented are generalized. We would encourage users to revise the plan to meet their specific needs as reflected by the student population and the individual school system.

Phase I: Pre-Implementation

Program Compatibility

The first step in any evaluation should be to determine if the program is compatible with the predefined goals and objectives of the course. That is to say, an evaluator must have a clear idea of the various ways in which the courseware can be used and an understanding of the user population.

Tyler defines evaluation to be a process for "finding out how far the learning experiences as developed and organized are actually producing the desired results" (Tyler, 1949). This implies that the desired results or goals of a program should be established prior to program implementation. When analyzing pre-designed instructional materials for use as part of a course offering, it is necessary to establish course goals and investigate whether these goals can be met using the specified CBE program. The goals set forth by the school system and by the program developers should be parallel.

Goal formulation is an important process in the development of any course, It identifies, from the onset, the intended purposes for instruction. Identifying desired outcomes makes it easy to assess whether a program will be able to meet specific needs. A comparison of course goals to the pre-designed program goals provides a simple method for the screening of CBE programs.

Another important aspect to consider when reviewing CBE programs are the terms under which they may be used. Unless a CBE program is developed "in-house," a contractual agreement is made between the program developers (or distributors) and the intended users, specifying the conditions under which the program may be implemented. The terms of this contract can play an important role in decisions about evaluation. Depending upon the licensure agreements, revisions to the materials may not be allowed. Most contracts however, allow users to make minor modifications which will tailor the program to meet course goals and objectives.

Before the program is ready for distribution, it should have been subjected to formative and summative evaluations. A field trial of the materials should also have been conducted. The strategies employed and the final results of the evaluation should be published with the materials. This review will give you insights into the effects of the program with a specific target population and the attitudes of the participants towards the materials. Programs which have undergone formal evaluation procedures will have an added validity.

Content Evaluation

Perhaps one of the most important aspects of effective CBE is the accuracy and validity of the information which is presented. As CBE programs are self-contained instructional units, learners must rely on the program to contain information which is accurate and relevant to the pre-specified goals.

The review of the materials in this stage of the evaluation should be done by a content expert. The content expert can identify information which is incorrect or out-of-date. He may also be able to make comments on the sequence and organization of the concepts which are presented, length of the presentation and the relevancy of the examples or models which are used.

Several authors (Bunderson, 1980; Mitzel, 1980; Douglas, 1982; Montague, 1972; Sedlak, 1972; and Northwest Regional Educational Lab, 1981) have indicated criteria which can be used to analyze the instructional design of a particular program. Below is a compilation of the considerations which should be made when deciding on the effectiveness of the design of a CBE program:

1. Objectives are stated and expected student performance is well defined.

2. Prerequisite knowledge and skills are identified.
3. Sequence of the content is properly organized; Information presented moves from simple to complex.
4. Examples are from common experiences.
5. Color, graphics and sound are of high quality.
6. Students are addressed in a personal style.
7. Narratives are conversational.
8. Student interaction is provided periodically.
9. A variety of formats for student responses is provided.
10. Designed to anticipate a wide range of student responses.
11. Feedback follows responses.
12. Provides positive reinforcement and non-threatening feedback.
13. Feedback gives cues, hints for incorrect responses and reinforcement for positive responses.
14. Branching is provided for remediation.
15. The learner controls the rate of instruction.
16. A progress report is provided to the student.

Another aspect of computer based educational programs which is important to review is their ability to store information pertaining to student responses. The program should be able to keep a record of each student's responses to individual questions and students' responses to test items. It is important for the course advisor or instructor to have a continuous record of students' progress as this is their most available source of information concerning students' comprehension of the material. Students should also have feedback so that they may identify areas·where they need more review. This information can be used in the formative evaluation stage as well to identify problem areas in the course content.

Hardware Considerations and Selection of the Population

One of the problems that is most likely to occur when using CBE is the lack of computer terminals available for student use. Considerations such as software compatibility with existing computer hardware should have been made prior to investigating CBE as a possible alternative for course instruction. In the evaluation stage, the task is to determine the maximum number of students that would be allowed to participate in the course. This decision should be based on estimates of the number of hours per week a student will need to interact with a terminal.

Also, at this stage in the evaluation, decisions should be made as to the selection of the students for the CBE program if comparisons are to be made between the CBE course and a traditional course. It should be decided whether students will be randomly assigned to programs or if the choice will be voluntary. A complete plan for evaluating comparison groups is presented in Phase III.

Phase II: Formative Evaluation

Individual Lessons, Students' Progress and Understanding of the Content

As previously mentioned, the CBE program's ability to keep track of students' progress makes formative evaluation relatively simple. The instructor or evaluator has the necessary records to review responses to individual questions and test items. Questions which received a large percentage of incorrect responses should be identified. Then the question or test item itself should be reviewed for clarity and content. If the question presents no problems in these areas, the tutorial material related to the question content should be reviewed to ensure that correct information and prerequisite knowledge were presented.

Another extremely helpful idea which can easily be implemented on the computer is a student response and attitude log. At the end of each session, students can be asked to comment on areas of the presentation where content was confusing or directions were unclear. They can also be asked to give their general feelings and opinions about each individual lesson.

Based on the findings of the students' log and question response records, modifications to the content or question structure can be made. After changes have been made, students can be asked to review the content again and give their opinions as to whether the changes made an improvement (Sedlak, Borman, Cartwright, 1972).

Continued Availability of Equipment and Time Records

The use of computer hardware is obviously mandatory in the implementation of CBE programs. Therefore, it is important to monitor this aspect of the program. Two types of information can be obtained from this monitoring.

Time Records: To make proper decisions about individual lessons as well as decisions about hardware, records of student time spent on the terminal for each lesson should be maintained. Students can be asked to keep these records and modifications can be made to the CBE program to do this. (Many computer programs give the date and time when they are first accessed.) The students or computer can maintain a record of this information before they begin the lesson and after they complete the lesson. The time of day should also be recorded.

The information obtained on time spent on each lesson can be used to ensure that the amount of content presented per lesson is not too exhaustive. If one lesson takes considerably longer to complete than the next, the content could possibly be divided between the two.

Data obtained on the time of day the students use the computer gives information on peak hours of use. This will give insights into whether the number of terminals available meets the needs of the students participating in the course. From this information, decisions can be made concerning future hardware needs, the maximum number of students who can enroll in the course and can also provide information to the students on the best possible time for available terminals.

Phase III: Summative Evaluation

Student Attitudes

It is always favorable to collect the attitudes of participants towards a program they have recently completed. Their attitudes and opinions of the course can have a major impact on the program's future effectiveness.

The most widely used instrument for the collection of attitude data is a questionnaire. According to Bruce Knerr (1978) and Sedlak, Borman, and Cartwright (1972) in the *College Students Journal,* the attitude questionnaire should cover course format, equipment and the hardware settings, feedback, and comparisons to other instructional formats. Specific questionnaire items might include questions about program content, equipment problems, and whether the format was boring or impersonal.

Another method which can be employed to assess student attitudes is the informal interview or observations of the students as they interact with the computer terminal. Without the pressure of providing a formal critique of the course, students may be more willing to provide detailed comments on their reactions to the structure of the course. Often informal small groups discussions will spur conversation about ideas and opinions that might not otherwise be reported.

Comparison Study

A commonly used method to assess the effectiveness of a CBE program is to conduct a comparison study of the CBE course with a traditionally taught course. Scriven states that if the cost of a program is an important factor then a comparison study should be conducted (Scriven, 1973).

Controls: To determine the most accurate results of a comparison study, it is necessary to control as many variables as possible. When comparing two types of instructional formats it is necessary to ensure that the content presented in both courses is as similar as possible. It is even recommended that the same instructor be responsible for both courses. It is assumed that this instructor would be completely familiar with the content of the course.

The student progress measurement instruments should be identical for both groups of participants. Each group should be required to take identical pre-tests and post-tests. The results of the tests can then be analyzed to assess differences between the groups. If no significant statistical difference is found or the scores of the students participating in the CBE course are higher than their counterparts in the traditionally taught course, it can be said that the CBE course is a viable course alternative.

Cost Effectiveness

No matter what method of instruction is used to disseminate information, cost is involved. Usually when a new approach to instruction is being considered, availability of personnel, efficiency of the instruction, or cost are key factors in the final decision on the approach to be used. Therefore, it is important to estimate the cost effectiveness of a course being offered via computer assisted instruction. Kearsley recommends that the following be considered when estimating the cost of a CBE program (Kearsley, 1977):

1. Cost of the license to use the program.
2. Costs of updating the software.
3. Hardware expenses.
4. Costs of the communication lines.
5. Life span of the content.

Then he recommends that the benefits be weighed against the costs to obtain an estimate of the cost effectiveness of the program. Benefits include such things as increased computer literacy, potential ability to serve large numbers of students, the self-pacing aspect of the program, and the ability of the student to replay the material.

If the estimated cost of the program exceeds the cost of alternative approaches of comparable effectiveness, then the use of the CBE program should be discontinued.

External Influences

Several authors of evaluation models and CBE evaluation studies (Knapper, 1978; Lysiak, 1976; Scriven, 1973), suggest that external influences or secondary effects be reviewed to assess their impact on a curricular program. Effects from several different areas as well as non-obtrusive indicators might be reviewed.

In a realistic sense, the opinions of the administration of a particular school are important considerations as are many decisions pertaining to the implementation of a program. If they view the material as having a positive effect on the students, both in the course and potential future students of the course, they are more likely to support the endeavor. In any perspective, their support or non-support may be a very influential factor on the final decision of worth of the program. Therefore, it is suggested that their opinions be solicited.

Administrators may also be the best source of information on the institutional effects of the program. This is a particularly important consideration with a program such as CBE. The institutional effects may very well be positive ones: providing students with a chance to explore the ever-increasing computer world, indirectly increasing computer literacy, and having computer equipment available for other uses. Some people also feel that the expansion of computer use may have a drastic effect on the characteristics of traditional teaching methods. It is necessary for an evaluator to take into consideration these effects and the outcomes they are likely to produce when making a value judgement on the effects of a particular curricular program.

Another very important group of people to interview concerning the program are colleagues and peers, especially those involved in teaching courses of similar content. They can give insights into the adequacy of the course content and the physical structure of the program. Here again, their opinions and attitudes on the positive and negative effects of the program may be an important consideration when deciding upon the continued use of a program.

One last group who should be polled concerning their opinions about the program are the students enrolled in the traditionally taught course. They can provide information on the method of instruction preferred, how the attitudes of their peers in the CBE course affected them, and whether they would like to participate in a CBE course in the future.

Decision of Worth
The final process of a course evaluation is to arrive at a "statement of worth" of the program. Once the data has been collected, it needs to be analyzed and a decision should be made as to the continued use of the program. It seems that this decision should be a "black and white" issue, but often it is not. The data may contain conflicting results and then one must decide if the positive effects of the program outweigh the negative effects or if another approach would be a more viable alternative.

All in all the process of evaluation is an important procedure which should be used to assess the value of any curriculum. Decisions about the curriculum should not be based on the findings of one aspect of what should have been a thorough evaluation. Although an evaluation procedure may seem to be all-encompassing, the time spent conducting the evaluation may well outweigh the time spent in corrective measures for a curriculum which did not meet prespecified goals. The outline presented here for computer assisted instructional programs provides a framework which can be used to provide the information which will be necessary to make a final decision of worth concerning a curricular program.

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