DOCUMENT RESUME

ED 200 215 IR 009 249

AUTHOR	Spannaus, Timothy W.
TITLE	Speculations on Computer Assisted Design of Instruction.
PUB DATE	Oct 80
NOTE	8p.; Paper presented at the National Conference on Computer Based Education (Minneapolis, MN, October 23-25, 1980).
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Computer Assisted Instruction; *Computer Oriented Programs; *Instructional Design; *Instructional Materials; Productivity

ABSTRACT

A system of computer assisted design for instructional materials (CADI) would increase the productivity of instructional designers of software, and keep costs from escalating as rapidly as they are at present. At Wayne State University, some steps toward CADI have been taken, with the result that personnel time has been reduced for some activities, and the product improved in others. A PLATO lesson that was designed involved the use of a questionnaire employing a 2-level sort--one by the courses the respondent had taken, and one by the design and development functions performed by the respondent. This simplified data gathering and improved the quality of the data collected. CADI also uses online documentation and interaction where appropriate. While the system can be used for preparing text materials, the greatest potential is probably for lesson development. The Instructional Quality Inventory developed by David Merrill provides a set of guidelines that may be useful in designing such lessons. The evaluation of CADI materials, while not completely precise, can be accomplished by reviewing their accuracy and conformity to accepted practice, but only the test of a prototype will tell if the instructional package works. (BK)

SPECULATIONS ON COMPUTER ASSISTED DESIGN OF INSTRUCTION

A Paper Presented at
The National Conference on Computer Based Education
Minneapolis, Minnesota
October 23-25, 1980

Timothy W. Spannaus
Research Assistant
Computing Services Center
College of Education
Wayne State University

*THIS PAPER WAS PREPARED USING *FORMAT AND PRINTED ON THE XEROX 9700 LASER PRINTER AT THE WAYNE STATE UNIVERSITY COMPUTING SERVICES CENTER*

INTRODUCTION

The purpose of this presentation is to describe a much needed system of Computer Assisted Design for Instructional materials. The need for such a system can be identified, along with some characteristics of the desired system. Along the way, it will be useful to describe some pieces of such a system that already exist and are in regular use.

At other points, it will be useful to look at computer aided design and computer aided manufacturing, collectively known as CAD/CAM, for some insights into problems that we may wish to avoid in designing a system for computer assisted design of instruction.

In describing a system of computer assisted design of instruction, which we will call CADI, we will use terminology derived from a systematic instructional design model that many of you use. The steps in such a model include Analysis, Design, Development, Implementation, and Evaluation. For purposes of this presentation, we will assume some familiarity with the concepts and procedures of this common model.

By calling the system CADI, or Computer Assisted Design of Instruction, we are taking some liberties with the model. It will be apparent that we are discussing computer applications useful for all phases of the effort, not just design.

We will also assume familiarity with the PLATO system, including characteristics of different kinds of lessons and the terminology of the system. Where it becomes necessary to describe programs running on other computer systems, we will describe them in somewhat more detail, because we cannot assume familiarity with other systems.

As vague as these assumptions are, we will expect that you will stop us whenever you feel more explanation or justification is required.

NEED FOR CADI

While the cost of computer hardware continues to decline at a rate that is unparallelled in other industries, the cost of computer software and courseware continues to rise. It is not at all unusual for software costs to run at five to ten times the rate of hardware costs for any given application, and the gap continues to widen.

The major reasons for the high cost of useful software, including courseware, are rising costs of personnel and slow increases in productivity of those who design and develop software. The slight increases in productivity have come as a result of improved packages useful for instruction, such as PLM.

Major improvements in productivity are unlikely until major steps are taken to automate portions or all of the design and development process, to reduce the number of person-hours necessary to bring courseware to completion. Or, if the same number of person-hours can produce better courseware, that would also be reckoned a productivity gain.

The use of computers to improve productivity has ample precedent in other endeavors. For example, design of camera lenses used to be something of an art. A few lensmakers, most of them German, produced most of the innovative lens designs, up until a few years ago. The art consisted of the ability to determine appropriate tradeoffs in lens design well in advance of the prototype stage. The laws of optics are well-known, but the multitude of variables in lens design limited the usefulness of calculations done by mechanical desk calculators.

The introduction of computer lens design drastically changed the process. It became possible for relatively unsophisticated companies to produce very innovative optics by the use of computer models. These models systematically manipulated variables such as curvature, placement, movement, type of glass and coatings, to produce very complex lenses, whose characteristics were known before the prototype was ever built. The result has been smaller, lighter lenses, of improved quality, at competitive prices.

There are some enormous difficulties with moving this very successful model to the design and development of instructional materials. But before we get bogged down in these problems, we need to look at some of the tentative steps that have been taken toward CADI, the computer assisted design of instruction.

TENTATIVE STEPS TOWARD CADI

At Wayne State, we have taken a few small steps toward CADI. In some cases we have reduced personnel time required for certain activities. In other cases, we have improved the product. Both are productivity gains.

In the Analysis phase, we have designed and used a PLATO lesson that simplifies data gathering and improves the data that we are able to get. We used an on-line questionnaire that would be quite impossible to duplicate using pencil and paper instruments.

You have all seen questionnaires that had questions that were used to sort out responses to later questions. They read like this: "Have you completed the course titled Instructional Design? If your answer is no, please skip to question 21. If yes, please go on."

That kind of question is acceptable in most questionnaires. But in our instrument, which was used to gauge the usefulness of the CREATE curriculum to practicing instructional developers, we could not sort by one or two questions of this type. Our need was to sort by both the courses a respondent had taken in CREATE, and by the design and development functions performed by the respondent, so that people only answered questions about which they had had professional experience. An example may clear this up:

> *Suppose a respondent to the questionnaire had completed the Fundamentals course, the Design course, and the two Author Language courses. In the respondent's job, he or she was responsible for design and management, but did no programming.*
>
> *Since we only wanted responses of these with experience related to the courses taken, this respondent would then get questions about the Fundamentals course and the Design course, but not the Author Language courses.*

This two-level sort is simply not possible in a paper-and-pencil questionnaire.

Another characteristic of this lesson set it apart from the usual questionnaire. The questions were Likert-scale items, in which the respondent moved an arrow along a line from 'strongly disagree' to 'strongly agree' to indicate a choice. If the response was at an extreme for some crucial items, the lesson prompted the respondent to write a short note, much like that which occurs when some kinds of errors occur in lessons. The note was automatically titled with the question number, so we could determine what it was the respondent was writing about.

This use of the -notes- command allowed us to selectively use open-ended response items where they were likely to gather useful information, rather than in a scatter-shot manner.

We used a multiple signon, which was given to members of the sample, so that anonymity could be preserved.

As in most of our efforts, this one required the expertise of several people to make it work. I designed the instrument and the logic of the lesson. Steve Strickland of CDC in Southfield, Michigan, wrote the individual questions, and Paul Jung programmed the lesson. Many people at CDC's courseware group reviewed the instrument and made valuable suggestions for improvement.

We will be demonstrating the lesson and some of the products we have produced at the Resource Center on Saturday.

In the Design phase, we make heavy use of on-line documentation and interaction. Our use of text files, note files, and documentor files is not of particular note, since many development groups do the same things. We report them here, though, just to point out that these common activities could be part of a CADI system.

In addition to the facilities provided on PLATO for generation, storage, and retrieval of documentation, we use similar facilities on Wayne State University's computers. For some efforts, the use of other systems is far more useful than use of PLATO, simply because of access. Wayne State's mainframe facilities are accessible from hundreds of standard ASCII terminals scattered around the Detroit metropolitan area. If our subject matter experts or consultants find it easier to access the university system, we will use the powerful ediors of that system for preparation of design documents, content narratives, and the like.

Preparation of text materials is almost always conducted on the university system rather than on PLATO, since the output of that system can be in the form of camera-ready, justified text, with a variety of type faces and sizes, produced on a Xerox laser printer for a few cents a page. That system provides a dramatic improvement in productivity. The beauty of the system is that the text never hits paper until it is ready for the printer. The designers, subject matter experts, and consultants have worked the text over on-line, without the need for laborious re-typing at each stage.

If the final product is likely to be a PLM course, we may use PLM as a design and development tool. Many of you have used PLM as a delivery and mnagement tool for instruction. But we recognized that a design document for a curriculum includes much of the same text as will eventually be entered into PLM. The duplicated information comes in the part of the document that describes the individual learning activities, tests, and the like, at the level of individual lessons.

Objectives, learning resource descriptions, and the like, should not be retyped several times. We will enter them into modules and instructional units early in the development stage, along with test items that may have been developed as we worked through objectives, so that they are ready for us when we get to the lesson development stage. Prints of the modules are useful as design documents, and some clients review them on PLATO so we do not prepare separate documentation for that portion of the effort.

The use of automated data gathering from lessons and PLM is well-documented in many places, and presumably is familiar to many of you, so we will not discuss it further here. We don't do anything too startling in this area, but, like documentation, we mention it to note that this evaluation tool should be considered as part of a CADI system.

I think we ought to step back for a minute and look again at CAD/CAM for some insights into what we are doing.

In Computer Aided Design and Manufacturing, the individual pieces that will design a part and then control the manufacture of the part are well in place and widely accepted. The next step is to integrate the processes, to reduce the manual steps needed to make the whole thing work as a system. The Department of Defense has in fact begun development of an integrated computer aided manufacturing package, called ICAM, that, in effect, ties together all the disparate pieces of CAD/CAM, to reduce the manual interface that typically exists between various phases of design and manufacturing.

That step, again, provides us with some direction in the design of a CADI system. For a variety of reasons, the pieces that exist don't work together. We can produce design documents that include prints of PLM modules, but the pieces aren't compatible. So if we want a single document, we wind up typing parts of it twice: once into PLM and once again into the design document. Content descriptions that could well serve as introductions to CAI lessons or text readings may have to be retyped to bring them into the system where the text

will be used.

But the greatest potential for CADI is probably in lesson development. In the instructional development field, we are getting close to the point at which we can specify one of a finite set of instructional procedures, once we have classified the learning outcome that is desired.

The Instructional Quality Inventory, or IQI, developed by David Merrill under Navy sponsorship, provides a set of guidelines that may be useful in computer aided lesson design. The model requires that a designer classify learning outcomes according to a specific scheme. Once that step is completed, the IQI specifies in considerable detail, the exact steps a student should complete in order to master the objective. In conversation, Merrill has claimed remarkable success for the scheme.

If the claims are justified, the model provides a powerful tool for use in a CADI system.

PROBLEMS

Let's return again to CAD/CAM to see where we are. In manufacturing, once you have designed a part, or an assembly, it is possible to make a pretty fair judgement about the ability of the part to meet the specifications. To illustrate the point, let's look again at the lens design problem. If a computer model is used to design a lens, the model can also be used to measure characteristics of the lens, to a high order of accuracy, before the lens is built. The laws of optics are well known. The major difficulty is being certain that a lens can be built that matches the design. That is to say, the design of the lens can be evaluated using only the computer model, and most experts would agree on the results of the evaluation.

I'm afraid that evaluation at the design stage of instruction is not nearly as precise a science. A problem in the analogy begins to appear. We don't know the laws of learning as well as we know the laws of optics. We cannot evaluate an instructional design with the same sort of certainty that is applicable in manufacturing.

We do review the design for conformity to accepted practice, and for accuracy. But we have to build the prototype, and try it out, before we know what happens when students use an instructional package.

We need to do a lot more research into learning, to extend the usefulness of the instructional routines used in the IQI. At Wayne State, we have several dissertations in progress now that are looking at instructional design variables. I am certain similar studies are going on elsewhere. Tennyson at the University of Minnesota and Merrill at USC are working on these and related problems.

The results of such work will be that increasing portions of lesson development can be automated, which will improve productivity and

make our products increasingly useful and attractive.