DOCUMENT RESUME

ED 267 785 IR 012 153

AUTHOR Morrison, Gary R.; Ross, Steven M.

TITLE Memphis State Regression Computer-Managed Instruction Model.

PUB DATE Jan 86

NOTE 12p.; Paper presented at the Annual Convention of the Association for Educational Communications and Technology (Las Vegas, NV, January 16-21, 1986). For entire proceedings, see IR 012 121.

PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS Academic Achievement; Cognitive Style; Comparative Analysis; *Computer Assisted Instruction; Flow Charts; Individual Differences; *Individualized Instruction; *Individual Needs; Learning Strategies; *Microcomputers; *Models; Research Methodology; Teaching Methods

IDENTIFIERS *Adaptive Instructional Models; AECT Research and Theory Division Meeting; *Learner Control

ABSTRACT

While individualized learning strategies typically provide large amounts of instructional support, they also reply heavily on learner judgement to determine the amount of support required to achieve an objective. Frequently, these strategies result in high achievers selecting too much support and low achievers selecting too little. Interest in this problem led to the development of the Memphis State Regression Model, which systematically selects the amount of instructional support the learner needs. Three adaptive versions of the model were evaluated: (1) quantity of instructional support and incentives; (2) meaningfulness of problem-solving contexts; and (3) density of narrative text. The first study consisted of five treatment groups: individual prescriptions generated by the model, prescriptions based on ability, low or high levels of instructional support, and nonadaptively-varied instructional support. Results indicated that the adaptive group performed significantly better than any of the other treatments. The second model was evaluated via three studies which adapted problem contexts to the learner's interest. Results indicated that the context-specific groups performed significantly better in all three studies. The third study focused on the application of this model in a self-instructional unit covering 10 algebraic rules taught in an introductory college statistics course. Three versions of instruction were developed and administered to students via print or computer presentation--low, high, or learner control of narrative density. Learners in the computer model took more time with both the high- and low-density treatments; subjects in the computer mode of the learner controlled treatment also selected the high-density narrative more often, suggesting that they had less confidence when learning from information presented via a CRT screen. A list of references and a flow chart of the model are provided. (JB)

Memphis State Regression
Computer-Managed Instruction Model

Gary R. Morrison
Curriculum & Instruction

Steven M. Ross
Foundations of Education

College of Education
Memphis State University
Memphis, Tennessee 38152

Running Head: Memphis State Regression Model

Memphis State Regression Model

The advent of low cost microcomputer technology has aided the integration of computer assisted instruction (CAI) into the classroom. Typically microcomputer software is planned as an attractive and adaptive alternative to learning from a textbook or programmed instruction book. Software created by instructional designers and sophisticated programmers has taken advantage of the microcomputer's graphics and sound capabilities, learner inputs, feedback, and record keeping abilities to produce attractive and versatile products.

Initially, the attributes of CAI suggested a medium capable of presenting instruction in a new manner. Recent research, however, has suggested that CAI may be no more effective than traditional textbooks once the novelty of the medium has disappeared (Kulik, Bangert, & Williams, 1983). Clark (1983) suggests a research strategy (and possible an instructional design strategy) that emphasizes the instructional methods as opposed to the individual medium.

Accordingly, our main assumption in this paper is that one of the computer's most powerful capabilities lies in adapting instruction to the learner. Adaptive methods typically found in the commercially available software use a weak form of adaptation that relegates instructional decisions such as speed, sequence, and difficulty to the learner. The learner control or internal control method is adaptive only to the extent the learners can make the necessary instructional management decisions (Johansen & Tennyson, 1983). In contrast to the learner control method is the program control method, often implemented in computer managed instruction (CMI), in which the designer controls the learning environment. Applications of CMI can range from simple branching based on the learner's response to decisions of the number or types of examples the learner needs, or when to exit the instruction. A principal criticism of the program-controlled method is the designer's ability to establish program control logic on criteria other than arbitrary and unvalidated rules (e.g., 80% correct; "3 misses in a row").

The purpose of this paper is to review three systematic adaptive instructional models used for computer-based curricular management. The types of adaptations included are (a) quantity of instructional support and incentives, (b) meaningfulness of problem-solving contexts, and (c) the density of narrative text. The first two models have been extensively examined in our prior research and evaluation studies. The third (context density) model is still in the devolopmental stage, and we will only report our preliminary findings in this paper.

Memphis State Regression Model

Individualized learning strategies (e.g., Keller, 1978; Bloom 1976) provide large amounts of instructional support, but typically rely on the subjective judgments of the learner to determine the amount of support required to achieve an objective. Frequently, these strategies result in high achievers selecting too much support and low achievers selecting too little support. Interest in this problem led to the development of the Memphis State Regression Model for systematically selecting the amount of instructional support an individual would need to achieve the objectives (Hansen, Ross, Rakow, 1977). The initial application of this model was directed at a self-instructional unit covering 10 algebraic rules taught in an introductory college statistics course. A flow diagram summarizing the steps of the model is shown in Figure 1.

Insert Figure 1 about here

Implementation. The following is an explanation of each component step of the model. Step one was the selection of pretask (entry behaviors) variables to use as predictors of learner performance on the task. This predictive process is the foundation of the adaptive model with the basic rule of "if predicted performance is low, increase instructional support; if high, decrease instructional instructional support." The second step was the development of a predictive equation for each lesson (one per rule) from the results of a sample group. In the third step, the predicted scores were matched to instructional prescriptions specifying the number of examples the learner would require for each lesson. The prescriptions were incorporated into a computer program to generate a prescription for each learner. Prior to the treatment, the instructional booklets were arranged for each learner according to the computer generated prescription for each lesson. The lessons were then presented to the learner, and at the end of each lesson, a formative posttest was administered. Lesson posttest scores were used to make necessary refinements in the next lesson (i.e., adding or subtracting examples).

Evaluation of the model was performed in several studies. The first study (Hansen et al) consisted of five treatment groups. One adaptive treatment received individual prescriptions generated by the model. A second treatment, group-adaptive, received a prescription based on membership in a particular ability group. Two other treatments received either low (2 examples per rule) or high (10 examples per rule) levels of instructional support. The fifth group received instructional support that was varied nonadaptively. The results indicated the adaptive group performed significantly better than each of the other treatments. Of particular significance was the difference between the adaptive group and the high instructional support group. It was hypothesized the disadvantage of the high support group was due to inefficient use of instructional time. A second study (Ross & Rakow, 1980) comparing individualized-adaptive prescriptions to group-adaptive prescriptions and non-adaptive instruction also found the individualized-adaptive strategy to be significantly better than the group-adaptive and non-adaptive strategies.

Incentive Adaptations. An extension of the Memphis State Regression Model is the varying of incentives (Ross & Rakow, 1981). Incentives (normally 10 points per lesson) were divided so the lesson predicted to be most difficult was worth more points (e.g., 20 points) than the lesson predicted to be the least difficult (e.g., 0 points). The adaptive incentives strategy served to orient the students to make the most effective use of the materials. Significant learning gains were found for the adaptive incentive strategy over the standard incentive strategy (equal distribution of points).

The most powerful application of the model can be realized through a CAI system which updates the instructional prescriptions with each individual response or group of responses. These components create an "intelligent" system that varies the materials as learner's needs change during the course of instruction.

Context Models

A concern related to adapting how much is learned to individuals is to vary what is learned. The specific interest leading to the development of this latter model was the student's difficulty in solving math story problems (National Assessment of Education Progress, 1979). When the themes of the problems are abstract, unrealistic, or highly technical, the learner is faced with the difficult task of translating the meaning of the unfamiliar words and procedures, and then performing the necessary computations to arrive at the answer. The objective of this model was to adapt the problem contexts to the learner's interests to promote meaningful learning.

Implementation. The context model has been implemented in a PSI course (Ross, 1983) and on a CAI lesson (Anand, 1985). The first implementation involved the development of context examples related to the background of the learners, who were all educators, in a statistics course. Meaningful, educationally-related referents such as teachers, students, and homework were substituted for the abstract referents of "X", "Y", etc, (Ross, 1983). In other tests of the model, the context was personalized to the preferences and environment of the individual learners as obtained from questionnaire responses. This information was then stored as data in a computer program written in BASIC. Problem "templates" were stored within the program which could incorporate the learner's data to personalize the context. For example, if a student's favorite food was pizza and he had three friends, Billy, Joe, and Sam; the program would present a problem asking how he would divide the pizza between these friends and himself.

Results. In one study, Ross (1983) presented educators in a PSI course with instruction including context examples related to education (adaptive-education context). A second group received instruction with examples from medicine which substituted doctors, nurses, and patients for the referents. A third group received abstract examples using the referents of "X", "Y", "Event A", etc. The results indicated that the adaptive-education context group performed significantly better than the non-adaptive medical context group and the abstract context group. Nurses were used in a second study to determine if the results were due to the examples presented in the educational context, or to the adaptive-context strategy. The nurse sample performed best with medical-related contexts. These results were consistent with first study indicating that relatedness of context to student background comprised the critical factor for learning.

In a third study, Anand (1985) investigated the personalization of the context as an adaptive strategy with fifth and sixth-grade students in a math class. The first treatment consisted of abstract contexts using terms such as quantity, fluid, units and so on. The second treatment consisted of concrete context examples that used realistic hypothetical referents (e.g., Mrs. Smith, orange juice, etc.). The third treatment consisted of personalized context examples generated from the personal data collected prior to the instruction (e.g., best friends, favorite food, birthday, etc.). Results indicated that the personalized context group performed significantly better than one or both comparison groups on measures of conventional problem solving, transfer, formula recognition, and task attitudes.

Context Density Model

The third model, context density, focuses on systematic variations of narrative text as an adaptive strategy. Our interest in investigating this strategy is to tailor the context or text explanations to learner's needs, and to the attributes of the medium (specifically, computer versus print) to enhance comprehension and perception. Perception concerns the learner's attitude towards the instruction based on prior knowledge (Johansen & Tennyson, 1983).

The context density model builds on the support models previously described and other related studies (e.g., Rothen & Tennyson, 1978). The current model, however, differs from the support models which focus on the the more limited property of number of examples presented. Context density manifests itself in sentence or phrase length, degree of elaboration and redundancy, amount of contextual support, and linkages between major concepts. This model provides a means for restructuring the text by varying contextual density to meet individual needs without loss of comprehension as suggested by Johansen and Tennyson (1983). We have hypothesized that learners with a high learning aptitude or prior subject matter experience may be able to learn more efficiently from a less dense narrative without loss of comprehension. Similarly, learners with lower aptitude or no prior background may require a more dense narrative as contextual support for the information to be learned. This hypothesis is consistent with current schemata theories (Anderson, 1984; Rumelhart & Ortony, 1977) which suggest comprehension is facilitated by existing knowledge structures. Variations of context density as an adaptive strategy could possibly meet the varying needs of the learners.

A second area of interest with the context density model is the interaction with presentation mode--computer versus print. This interest in optimal use of instructional methodologies, not the delivery of the instruction, is consistent with Clark's (1983) proposal for research with the media. Are there possible interactions with the different context densities (i.e., high and low) and presentation mode due to delivery system constraints or attributes that will enhance or hinder comprehension? For example, what are the effects of the reduction of the CRT screen presentation to only 24 lines by 40 or 80 columns, or the lack of traditional cueing mechanisms such as bold and italic text, and underlining? Is there an expectation on the part of the learner to "see" less information on the CRT screen and more on a printed page, thus requiring more effort on the learner's part to comprehend the message presented on the CRT screen?

Implementation. In our initial study, two forms of instruction were developed using a section from a self-instruction statistics book developed by one of the authors. The low density version was developed according to a systematic algorithm for deleting extraneous and repetitious material in the high density text (original version). The stimulus material consisted of textbook and computer versions of the low and high density presentations. The computer version, written in Apple Superpilot, allowed the student to refer back to previous screens by pressing the B key.

Our pilot study consisted of print and computer presentation modes with either high density narrative, low density narrative, or learner control of narrative density. After collecting data on 35 subjects (approximately 6 per treatment), there appears to be a trend for learners in the computer mode to take more time in both the high- and low-density treatments. There is also a tendency for the subjects in the computer mode of the learner controlled treatment to select the high density narrative more often than subjects in the print mode. It appears that learners in the computer mode have less confidence when learning from information presented via a CRT screen.

Future investigations will use context density as an adaptive strategy to present high or low density narrative according to predicted learner needs generated with the multiple regression model used in the instructional support model. Applying the general rule for the support model, context density will be increased as the predicted score decreases; and context density will be decreased as the predicted score increases. Planned extensions include the refinement of the model to include varying degrees of context density instead of the two discrete levels now used.

References

Anand, P. G. (1985). Using computer-assisted instruction to personalize arithmetic materials for elementary school children. Unpublished doctoral dissertation, Memphis State University, Memphis.

Anderson, R. C. (1984). Some reflections on the acquisition of knowledge. Educational Researcher, 13, 5-10.

Bloom, B. S. (1976). Human characteristics and school learning. New York: McGraw-Hill.

Clark, R. E. (1983). Reconsidering the research on learning from media. Review of Educational Research, 53, 445-459.

Hansen, D. N. Ross, S. M., & Rakow, E. (1977). Adaptive models for computer based training systems. (Annual report to Naval Personnel and Development Center). Memphis, TN: Memphis State University.

Johansen, K. J., & Tennyson, R. D. (1983). Effect of adaptive advisement on perception in learner-controlled, computer-based instruction using a rule-learning task. Educational Communications and Technology Journal, 31, 226-236.

Keller, F. S. (1968). "Goodbye teacher...". Journal of Applied Behavioral Analysis, 1, 79-89.

Kulik, J., Bangert, R., & Williams, G. (1983). Effects of computer-based teaching on secondary school students Journal of Educational Psychology, 75, 19-26.

National Assessment of Education Progress. (1979). Second assessment of mathematics: Mathematical applications. (Report No. 09-MA-03). Denver, CO: Educational Commission of the States.

Ross, S. M. (1983). Increasing meaningfulness of quantitative material by adapting context to student background. Journal of Educational Psychology, 75, 519-529.

Ross, S. M., & Rakow, E. A. (1980). Adaptive design strategies for the teacher managed course. Journal of Instructional Psychology, 7, 13-19.

Ross, S. M., & Rakow, E. A. (1981). Learner control versus program control as adaptive strategies for selection of instructional support math rules. Journal of Educational Psychology, 73, 745-753.

Rothen, W., & Tennyson, R. D. (1978). Applications of Baye's theory in designing computer-based adaptive instructional strategies. Educational Psychologist, 12, 317-323.

Rumelhart, D. E., & Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro, & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. (pp. 99-135). Hillsdale, NJ: Erlbaum.

Figure Caption

Figure 1. Memphis State regression model

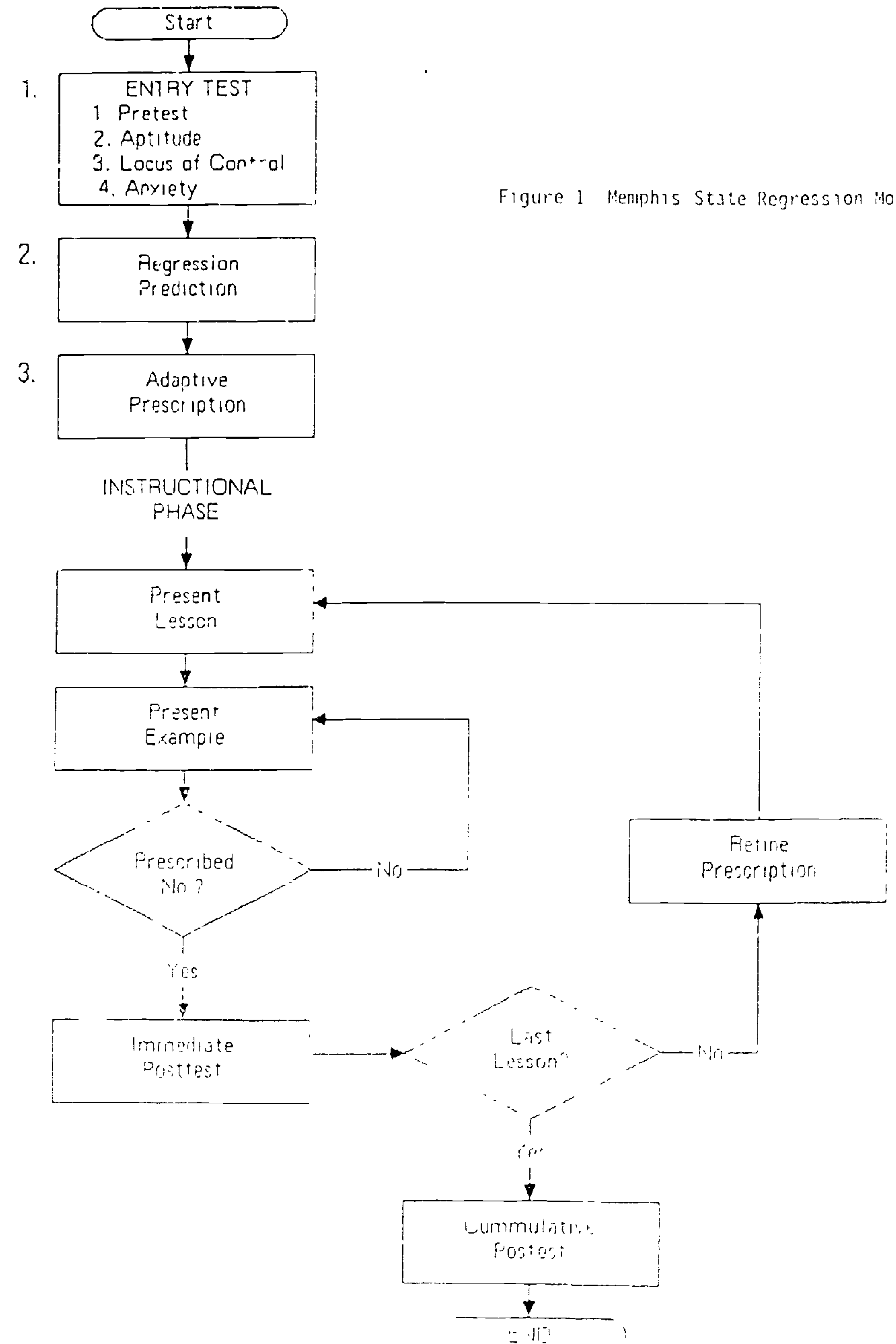

Figure 1 Memphis State Regression Model