NEXT MAJOR STEP FOR CAI IN IBM'S FIELD ENGINEERING DIVISION

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From the early 1960's, IBM's Field Engineering Division has maintained a very strong commitment toward individualized learning. Initial efforts addressed the application of programmed instruction. Extensive research in the mid-1960's led to the implementation of a nationwide CAI system in 1968. In the early 1970's the IBM World Trade Corporation extended CAI to some one hundred countries throughout the world over a sophisticated telecommunications network which included the use of a satellite.

Approximately 20 percent of IBM's maintenance training in the United States is presently being accomplished via individualized instruction administered from a centralized computer through IBM 2740 terminals located at branch offices throughout the country. The present system incorporates a wide variety of media in the form of microfiche, films, filmstrips, and actual devices. A good deal of the material is presented at the terminal, although the direction has been toward use of the terminal for more complex learning situations, for example, simulation. The existing system has provided a substantial base from which design efforts for a future CAI system could proceed.

A new CAI system planned for the mid-1970's will employ an IBM 3270 Information Display System with light pen capability. By piggybacking on the IBM Corporated Data Net, training will be time shared with other applications for more cost-effective use of the telecommunications network.

The objective of the new system is to provide increased student interaction with the system in problem solving and simulation exercises. More of the tutorial will be shifted to hard copy and audiovisual presentation with the faster display and increased computational power devoted to the more complex interactive situations. The student will have greater control over his learning environment through increased course modularity, learner review options, summary reviews, and standard fast track options.

The increased capabilities of the planned IBM Field Engineering Division CAI system will permit over 50 percent of domestic maintenance training to be accomplished at the individual's job location. The focus of this presentation will be on the key aspects of this new CAI system.

In the military, in industry, and in public education, a major trend over the past decade has been toward increasing the individualization of instruction. There has been more emphasis on matching the learning time to the abilities of the student. At the same time, there has been a move toward tailoring training content to the needs and background of the student. The methods for accomplishing learner individualized training have varied widely

--from rather uncomplicated direction to the student into extant materials made possible by more specific training objectives--to complex computer managed adaptive training sequences. These are organized around the student's previous experiences, his specific educational or training needs, and his individual performance throughout the learning process. Today I plan to discuss the background, development, evolution, and more specifically, the future plans of an instructional system more closely likened to this latter description.

IBM's Field Engineering Division is responsible for installing and maintaining IBM data processing products and for supporting programming systems. Thousands of maintenance personnel--Customer Engineers--serve to carry out this task in some 200 branch offices throughout the United States. The technical nature of the job, changing products, and personnel movements all contribute to a substantial on-going training requirement.

In the early 1960's, there developed a growing interest in self-pacing instructional approaches. A series of controlled studies within IBM helped to identify the most cost-effective methods for creating an instructional system--a system which would more closely match the teaching process to the learner's needs. The studies and development effort led to the implementation of a nationwide CAI system in 1968. This was the beginning of the movement to bring the school to the student. Instructional material was teleprocessed to the student at his home office by way of an IBM 2740 communications terminal. The course material data base was maintained and distributed from a System/360 Model 50 in Poughkeepsie, New York.

In 1969, some forty-three thousand student days of instruction took place on about 70 courses. This amounted to less than 10 percent of the total training within the Field Engineering Division. By 1972, 35 percent of the training had been transferred from the schoolhouse to the employee's home office. Using an arbitrary definition for CAI as that form of instruction where over 50 percent of the student's time is spent at the terminal, only 3 percent of the total training was accomplished in this mode. The majority was in CMI where less than 50 percent of the student's time was spent at the terminal. One additional distinction has been made and is termed "computer controlled" instruction. Computer managed instruction implies some tutorial via the terminal--that is, some degree of student interaction with the course material while seated at the terminal. Some number of the courses will not have any tutorial through the system--rather, the system will serve more in an administrative capacity. This is termed "computer controlled" instruction.

The potential for greater cost effectiveness in training was recognized early in the implementation stage of the initial system. However, certain system changes were seen as necessary to extend the utilization beyond the present level. First, a faster and more acceptable terminal had to be found.

The IBM 3270 Information Display System with a light pen capability was selected to fulfill the requirement. Second, a more extensive application of problem simulation would be a necessity. To achieve an objective of 58 percent of total training at the student's home office by 1979, approximately 25 percent of the course materials would consist of simulation exercises. This would involve student problem-solving exercises for programming systems, as well as hardware malfunctions. A long range strategy was developed which incorporated a number of special projects and checkpoints to insure the new instructional system would meet objectives.

A training system is far broader than the presentation media, although a reliable and acceptable complement of media are extremely important. Instruction will be accomplished at the display terminal, as well as through hard copy texts, microfiche, films, slides, videotape, and hardware simulations. Hardware simulations will be used where less costly methods will not satisfy the particular skill development requirement. With the information display and its light pen capability, however, more realistic simulation exercises can be devised to reduce the overall need for hardware simulations. A printer will also be installed at each remote training location for training and administrative applications. A major aspect of improved cost effectiveness from a systems hardware standpoint is the projected consolidation of several major corporate teleprocessing functions into a single net: CCDN--Consolidated Corporate Data Net. The economies of scale provided by this consolidation may make CAI/CMI cost-justifiable over a broader scope of educational applications.

To insure the ultimate implementation of a viable system, there were a number of major considerations beyond that of hardware selection. These involved course planning, course evaluation, and student administration. Additionally, since many courses are presently administered under the existing system, conversion methods need to be looked at in detail. Also, to improve both student and management acceptance of the system, announcement and training approaches must be considered as an integral part of the implementation package. Several of these general considerations are worth further discussion.

Courses are presently structured according to a standardized course logic model. Major elements of a course are called "topics." These are generally 2 to 4 hours in length. Each topic is subdivided into an introduction section, a pre-test, teaching segments, post-test segments, remedial segments, and a conclusion section. The course logic will remain essentially the same in the new system; however, several improvements are planned.

First, while not planned for implementation at this time, a long range goal is to be able to tailor the course to the student's individual needs based upon an analysis of his training and experience at the task level. Courses would be compiled from task-oriented modules for each student. It looks like future course topics can be made more specific as they might relate to task performance. With this relationship better defined, the step to individual course compilation could be made with much less difficulty.

A second objective is to improve the testing methodology. Today, many of the post-test questions are repetitions of questions appearing in the teaching segments and in the pre-test. While the exact characteristics of the pre-test have not been defined at this time, it is planned that the testing will become integral with course content as the student proceeds from pre-test, through teaching segments, to post-test, and then perhaps to remedial segments. Increased simulation in the teaching segments will significantly enhance the capability for more integrative content. A similar simulated, problem-oriented post-test structure will carry the concept toward a more ideal overall instructional environment.

A third consideration is to place more of the instructional sequence under the control of the learner. This may mean a series of training level maps which permit the student to unfold content according to his personal learning desires. The previously mentioned concept of modularity is a necessary prerequisite for accomplishing this strategy. The availability of more problem-oriented post-test material makes the increased learner control a more viable approach.

A course can be no better than its author, which makes the development of highly qualified authoring personnel an important part of the overall instructional system. The need for this training is made more critical because of the increasing amounts of simulation and the conversion from a typewriter to a CRT for content presentation. A preliminary study is planned to develop presentation format guidelines to make the most effective use of the IBM 3270 blanking/unblanking, highlighting, field definition, and light pen features. These guidelines will constitute a portion of the author training program.

A major strengthening of the feedback and evaluation system is intended. Quality assurance guidelines will be developed in the areas of testing, materials, training content, and staff development. Feedback and analysis of performance problems administered during the course, of certain student/course/assistance factors incident to the learning situation, and of follow-on student/product performance as they can be related to the training situation will be strengthened. A course evaluation questionnaire (termed QUEST) has become a very beneficial tool in measuring course performance and in highlighting areas of weakness. Through its use, certain student factors such as interest and confidence are measured.

Tests of the student's attitudes toward course structure variables, such as course length, sequencing of material, and level of presentation, are also made. A standardized scoring system permits courses to be compared against criteria for determining their acceptability. Problem exceptions are identified to responsible functions for correction.

The student will have access to certain internal assistance features including a glossary of terms, a help feature, and a hint feature. In addition, backup assistance will be available through a centralized student assistance group. Use of this function, plus the availability of a student comment feature which permits him to convey information via the terminal on any aspect of the course, will create a major data source for evaluating and validating each course. The feedback and evaluation subsystem is integral to the training system and is extremely important for achieving the desired degree of technical and administrative quality.

This leads to a final point--that of the general administration of the instructional system. The decentralization of the schoolhouse presents administrative difficulties either not found or more easily rectified in a centralized training environment. The existing field instructional system has made many of the administrative difficulties rather evident--terminal scheduling - possibility of student disruption to handle work assignment - variability of environmental factors such as lighting, heat, noise, etc. - lack of an immediate source of technical assistance--and so on. Many of these have been corrected in procedural ways. Others have required student, administrative, and management training of varying degree. Specific training programs are planned within the implementation structure of the new system to prevent reoccurrence of prior problems.

In summary, the introduction of a new improved instruction system within IBM's Field Engineering Division will provide more cost-effective training with nearly 60 percent of total training conducted at the student's home office. Not only will system hardware be improved with the installation of the IBM 3270 Information Display System, but the total instruction process will give greater consideration to the student and his needs. The development cycle has focused on a variety of studies to bring about a systematic introduction as well as to ensure continuing quality in the instructional process.

ABOUT THE AUTHOR

MR. LARRY R. DUFFY is presently serving on the IBM Study Team for the Design of Training System, ADO 43-03X, contract between IBM's Federal Systems Division and the U.S. Navy. In his 18 years with IBM, over 12 have been devoted to maintenance training. Training assignments have included instructing; development of training simulators; and management of training engineering, course planning and course development functions. He recently completed his M.B.A. at Pace University in Professional Management and is presently a doctoral candidate at the same university.