DEVELOPING A COMPUTER GAME/JOB SIMULATION TO TEACH FUNCTIONAL LITERACY SKILLS

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ABSTRACT

An army project under contract to the University of Maryland's University College Center for Instructional Development and Evaluation has developed integrated videodisc/microcomputer instruction in functional literacy skills (math and reading).

Over several years, numerous lessons were built into story lines (scenarios) based on required job skills. These scenarios included tests and evaluation and some computer games. Other games were part of the lessons.

The project used state-of-the-art hardware and the best available information on instructional design for an adult audience. The team approach combined instructional designers, writers, subject matter experts, computer programmers, and systems designers.

PROJECT OVERVIEW

The Army's Continuing Education Division is currently using an integrated microcomputer/videodisc technique to teach functional literacy skills to wheeled vehicle mechanics and armor crewmen at remote sites in Germany. This computer-based instruction project, ongoing since 1979, was designed by the Center for Instructional Development and Evaluation (CIDE) at the University of Maryland's University College in College Park.

In addition to a new hardware system including single-screen integration of videodisc and high- resolution computer visuals and text, computer- generated audio, touch-sensitive screen, and hard disc storage, this project developed courseware using a problem-solving, job-related context for teaching reading and math skills. The aspect of the course- ware to be discussed here is the use of simulation in these lessons, particularly the time-travel simulation used for student motivation in the 1981-1982 level of the project.

Project Context

1979-81

The original project taught functional literacy skills to wheeled and tracked vehicle mechanics, using manual sections for lesson material, and culminating in a jeep trouble-shooting simulation. This early project had essentially linear lessons which used pretests and posttests to evaluate how much students needed to know and how much they had learned. Students progressed after two attempts at a lesson, because skills were taught over the whole range of lessons.

The final simulation used more branching to apply the skills students had learned. Students had to be able to select the correct page in the table of contents or the index, and apply the relevant information on that page to trouble shoot the electrical systems of a series of vehicles.

> A tree diagram depicted all possible flows from electrical diagnostic test to diagnostic test, and as the student progressed through the series of vehicles, s/he was allowed greater latitude to make mistakes without instructional input. This allowed the simulation to approach the reality of troubleshooting actual vehicles (which don't tell you when you make a mistake) [1].

This set of lessons was well-evaluated but did not make full use of the random access features of the computer either during or between lessons. The record-keeping properties of the computer were used, and use of new technology seemed motivating to the students.

1981-82

The 1981-82 project added a simulation scenario as a framework for the lessons and built the pretests and posttests into the scenario, along with problem- solving lessons. With a more complex hardware system, this complete set of lessons used more branching, games, and motivators than the 1979-81 lessons.

The gaming simulation contained problems which a student had to solve to go on. If a student made a mistake in solving a problem, the program branched to a unit of instruction teaching one skill which would help solve the original problem. In this way, the scenario provided the assessment for the lessons, as students who needed help and were branched into a lesson also received a posttest coming back into the scenario.

The simulation used the random access capability of the computer because lessons were received when needed. Because the units of instruction were organized into a hierarchy, only the skills needed were taught. Dividing learning objectives into skill units was particularly effective for the math lessons, as students could practice only those skills they needed to master.

1982-83

The 1982-83 project built on the growing expertise of the designers, as well as on more sophisticated equipment available. The earlier projects had based lessons on material in the soldiers' common task manual and job-related technical manuals, but the students were supposed to be learning how to read and use the manuals (basic skill education) rather than how to apply first aid, throw a grenade, or repair a vehicle (training). Since 1977, all on-duty educational programs of the military services have been required by Congress to be specifically related to job performance. The premise of this change is that training and successful job performance are based on possession of certain job skills [2]. Training and education are considered separate functions, however.

One important innovation of this project was the addition of three levels of assessment, from open ended questions, a more structured prompt question, to multiple choice questions. Based on direct application of the technical manual, as were the lessons, this more sophisticated assessment method enabled students to even more precisely individualize their lessons according to prior knowledge of the skills being taught. After assessment, students were routed through actual on-the-job tasks in a fantasy time [3]. Since the manuals have little narrative, the reading lessons were limited to reference, following directions and graphic analysis. The 1981-82 lessons had included higher level analysis skills, but these lessons had been based on Stars and Stripes and other material because the manuals contain few actual paragraphs.) Lessons were still embedded in the scenario to practice problem-solving skills.

Students again earned time warp energy units for completing lessons correctly and quickly, and these units were converted into missiles for the shooting game at the end of the lessons.

SIMULATION AS MOTIVATOR

Progressing from linear lessons of the early computer-based instruction type to a scenario with embedded lessons, the CIDE lessons used more and more simulation to motivate students. In the earliest project, students preferred lessons which applied functional literacy skills to job situations. They found the simulation useful because it made them use their technical manuals and helped them learn the value of the technical manuals. (Army manuals contain a great deal of necessary information but are not always written In ways best suited to getting the information across, particularly to an audience of nonreaders.)

The 1981-82 project was also well-evaluated by students, who thought that they learned a lot which they could transfer to their Army jobs. They were also enthusiastic about learning both basic and MOS skills on a microcomputer [4].

Of course, one of the strengths of the CIDE project was its use of state-of-the-art technology, both in hardware and courseware. The Army required that the instruction

--provide information in military contexts by using Army manuals as lesson sources,

--motivate soldiers whose previous educational experience has generally been negative, and

--develop problem-solving skills that require the use of the functional literacy skills the students were learning [5:1.

While many traditional methods of teaching by computer have been used, this project developed innovative but educationally sound methods in order to reach this difficult student audience. For a video game generation, two-way communication with machines seems natural (and necessary--one-way communication as in lectures or even old-style CAI is pretty widely rejected by these learners). Good new training needs to be

Engaging, by means of rapid response to one’s being there;
Relevant, and quickly, so that the context has immediate meaning;
Involving, so that the human soon has a “stake” in that interaction [6].

Because of the hundreds of coaching branches available through a videodisc, the computer can respond in a warm human way to student errors, still providing precise performance coaching. Simulation via photographs, films, computer graphic overlays, and job- like situations gives students a chance to pre-experience tasks and skills in a nonthreatening environment.

INTEGRATING INSTRUCTION AND SIMULATION

In the 1981-82 project, the original plans called for three separate simulations, one using functional literacy lessons, and two using MOS-related functional literacy skills. This proved to be too much for the staff of writers, instructional designers, and computer programmers to produce, and the final result was one simulation containing the functional literacy lessons, and a set of MOS lessons. Many of the excellent math lessons produced this year were subdivided and used in the next year’s project. More reading lessons were produced and formatted than were actually programmed. (PILOT Plus turned out to be a slow language to use when all the data base management of a complex branching system was involved.)

The simulation used in the STARS project (Space Time Army Reconnaissance System) walks a soldier through signing on the terminal (with branches for first and subsequent uses), introduction to the robot-like helper used for instructional help throughout the lessons, and mission description. This introductory material could be reused in the 1982-83 lessons.

The time/space travel machine is then introduced, and the soldier is told s/he will be testing the machine. To prove that it really works, the soldier must go back in time and bring back proof, in this case a form signed by General Patton. In the course of the simulation, the soldier goes through problem-solving lessons, and also lessons involving basic job skills such as following directions, reading a map, figuring calculations, and referring to a manual for information. If the assessment item that is part of the scenario is not completed correctly, the student branches to a lesson unit. Some lessons contained internal branching if the student needed even more basic skills. The lessons were based on military material, but were not a continuation of the Patton scenario, so they could be used in different places and times as needed.

Throughout the simulation, computer games were used to further motivate students. Correct answers earned time warp energy units which could be used to play shoot-’em-up games with planes, for example. (The 1979-81 project had included some negative reinforcers such as blowing up screen images. These proved too attractive, however, and were dropped in later versions.) Other games were integrated into the lessons, with math games including dice and random number games (some against time), and reading games including correctly camouflaging a face or vehicle with the touch sensitive screen, or moving up Rocky-like steps by answering questions on facts and inferences in a passage from Stars and Stripes.

The basic skills and MOS objectives were organized in a learning hierarchy according to difficulty, but were not necessarily embedded into the scenario in this order. In other words, an event in the scenario might include a graphic analysis skill, a couple of math skills, a reference skill, a following direction skill, and a step in problem-solving. All but the latter would have related lesson units to branch to if needed. When a student moved to the next skill embedded in the event, a new assessment item was part of the story line, and so on. Theoretically, a student could move through parts of the scenario without doing any lessons at all, if the skills were already known.

SUMMARY

Computer-based instruction has progressed a long way from early use almost as an electronic page turner. Simulation of job skills has long been used in training, from airline pilots to factory workers. The CIDE project's use of simulation to train basically unskilled workers in functional literacy skills appears to be a new and valuable use of a method formerly used to teach much higher level skills. Basic to teach much higher level skills. Basic skills training has to show how skills can be applied as well as introduce those skills in a nonthreatening way. Computer games and space/time simulation are ways of getting nonreaders involved in lessons, because these methods seem a long way from the schools and teachers that may have turned these learners off in the past.

This paper outlines the use of simulation as a scenario in which lessons are embedded and branched to. A number of papers on the STARS project have already appeared concerning other aspects of the project, and more will appear in the future, because of the innovative nature of the project. Members of the CIDE staff are pleased to explain the project to interested trainers. As an instructional designer during the 1981-82 project while on sabbatical, I was able to apply both communication and information systems skills and to learn a great deal about the instructional design and project management processes. Please let me know of questions about the instructional embedding process.

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