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Educational management in Israeli elementary schools

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Abstract

Educational management should be part of every well designed instructional computer system. A description of how pedagogical management is implemented in the systems developed by CET, both in the aspects of student-computer interaction and of class activity, is presented.

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1. SCOPE

This paper describes the educational management systems installed in some 700 Israeli elementary schools by the Centre for Educational Technology. Some 200,000 students, using 15,000 computer terminals, benefit from these systems.

2. THE CENTRE FOR EDUCATIONAL TECHNOLOGY

The Centre for Educational Technology is an independent non-profit organization dedicated to improving the Israeli educational system. Established in 1971 and initially endowed by the Rothschild Foundation (England), CET finances its activities mainly through the services it provides to schools, and receives financial assistance from various foundations.

In pedagogical terms its credo may be summarized by saying that students differ from one another in ability, background, experience, interests and level of knowledge, and that educational and training systems must recognize and respect these individual differences, and allow each student to learn according to his own capabilities and preferences.

Serving these ideas, CET's Department of Computers in Instruction has pioneered the utilization of educational management systems in Israeli schools since 1977.

3. THE SCHOOL COMPUTER SYSTEMS

The idea that the school computer system has to support the learning process of each student, providing each one with the assistance appropriate to her stage of cognitive

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development, was clear to us since the first TOAM systems were installed in 1977 (TOAM is the Hebrew acronym of "Computer-Assisted Testing and Practice"). Nevertheless, it is only now, with the development of our newest system, RAMA 3, which enjoys all the advantages of present day technology, that we can give this idea its full expression.

RAMA 3 is a complete computerized instructional system, composed of an instructional facility, an administration facility, and a software and courseware library.

The **instructional facility** consists of a personal computer equipped with all the software necessary to allow for a rich and varied student-computer interaction. All the personal computers installed in a school are linked by a local area network to the software-courseware library and to the administration facility.

The **administration facility** is the repository of student, course and statistical records necessary for instruction, student guidance, monitoring of student progress and evaluation, and improvement of instructional programs.

The **software and courseware library** includes all the computerized instructional materials designed to serve the multiple needs of different students and varied instructional processes. A balance has been achieved in the library between guided instruction (e.g., tutorial or testing and practice programs) and exploratory activities (e.g., simulations, games, tools).

4. THE STUDENT-COMPUTER INSTRUCTIONAL DIALOG

It is important to distinguish between two different types of instructional computer programs: those that can be presented in computer-guided mode, and those that can be presented only in free mode. The distinction between the two modes lies in the fact that in computer-guided programs the computer is able to judge whether the student is able to perform certain tasks correctly, whereas in free mode, this judgment is beyond the program capabilities. To exemplify, a program that presents a student with exercises whose correct answer is perfectly defined can be used in computer-guided mode; on the other hand, a student writing an essay using a word processor is working in free mode, because no word processor is able to judge the quality of the essay being written.

Both modes of interaction are equally important and attend to different facets of the instructional process. Computer-guided programs are essential if we want to provide instruction adapted to each student's needs, and they constitute the critical link with the teacher by transmitting to her or him objective and updated information about each student's status, progress and difficulties. Unfortunately (or not) computer programs cannot cope with sophisticated student inputs, and we should not limit the student-computer interactions to those which match our programming limitations. Free mode is essential for the development of exploratory skills, for learning how to enjoy all the possibilities offered by the joint technology of communications and computers, and as a tool to help in fostering creativity.

Let us describe how the student-computer interaction is performed in our school computer systems, first in computer-guided mode, and then in free mode.

When a student starts his activity at a terminal (a networked computer station), he must first identify himself. When the right to receive instruction is established, the basic student parameters are retrieved from the administration files in order to start initializing the **student model.** When a computer-guided courseware is then selected, the student data pertinent to

this course are retrieved also from the administration files, and the initialization of the student model is completed. At this point the student model includes all the available information about background and performance needed by the **pedagogical model** to decide on the appropriate instructional steps. The term "pedagogical model" embodies all the programming routines which, in some sense, try to simulate a teacher's decision process, i.e., what a good teacher would decide is best for the student to do when supplied with all this very precise information about the student's performance.

The pedagogical model's decision is expressed as a request to the **knowledge model** (embedded in the courseware or the courseware library) to present information to the student. This information may be expository or may require a student's answer (e.g., an exercise). This information is decoded from the library and presented on the student's screen. The (real) student's response to this stimulus will (immediately!) update the student model, and the pedagogical model will base its next decision on this updated model. This loop continues until the activity in this particular courseware ceases and, at that point, the data from the updated student model is stored in the specific student record on disk. Furthermore, all the statistical information related to this interaction with this courseware is stored in the specific courseware file, to be analyzed by the development team in order to improve, periodically, the courseware library.

The free-mode interaction is much easier to describe. Once the student's right to work with the system has been ascertained, he may interact with any free-mode program in the library as he wishes, without any supervision or guidance.

For the sake of completeness, let us mention an intermediate mode. Computer-monitored programs are free programs in which, nevertheless, data is collected about student activity. This information is not used for computer guidance (otherwise the program would be guided), but rather to convey information to teachers (who may want to know which computer activities a student invests his time in) and to developers (for improvement purposes).

5. A PARADIGM: TESTING AND PRACTICE

Testing and Practice (T & P) programs, born out of the pioneering efforts of Prof. Patrick Suppes at Stanford University, still constitute the best example of computerized educational management which helps improve class instruction.

The design of these programs derives from the experimental results of evaluating student performance in different school subjects, which show an enormous variance among children in the same class. T & P programs say: instead of continuing on the false assumption that all students in the same class are able to cope with the same instructional tasks, let us ascertain the cognitive level each student has reached in any given subject area, and let us continue, from that particular level, her instructional process.

CET has developed three major T & P programs, covering arithmetic for elementary school, Hebrew reading comprehension for elementary school, and reading comprehension in English as a Foreign Language, for elementary and junior high schools.

In each of these programs the student-computer interaction begins with an adaptive testing process whereby the effective "functioning" level of each student is determined. Thus, instead of blindly assigning sixth grade level exercises in arithmetic to a sixth grader, the system will carefully test the student (in a process that is accomplished usually during the first two weeks

of the school year) and if the student is not able to answer exercises beyond the third grade level, those are the exercises the student will be asked to answer.

When testing is finished, the teacher receives detailed class reports showing each student's level in each one of the three major subjects mentioned. From then on, the teacher should plan his or her class activities according to this reliable information provided by the computer management system. The reports available to teachers are designed to cope with the various needs that may arise when integrating class and computer activities. For instance, a teacher who wants to teach a specific topic and is willing to group students according to their knowledge in the topic, may request a "histogram report", where student names appear ordered according to the proficiency levels in the topic. With this help, forming the groups is a very easy task.

The class reports also include special symbols to alert the teacher about students' difficulties on particular subtopics, thus allowing for a very efficient treatment of these students' real needs. It is important to note that these special symbols add a dynamic component to the status report: In addition to knowing at *which level* a student is at each topic, the special symbols provide information on *how* she is performing.

It goes without saying that it is not enough to install computers in schools for teachers to change their instructional style. A strong effort is being made to provide the teaching staff with appropriate training and long term support. The 700 schools mentioned in section 1 are served by a team of nearly 50 CET instructors who provide a concentrated initial training (both in terms of pedagogy and of courseware acquaintance) when the computer system is installed, followed by monthly visits to each school in order to examine, with each teacher, the progress reports in each subject, and to provide advice on class organization. Each courseware addition is accompanied by in-service training to the teachers that may use it.

In addition to the detailed reports available to teachers, the computer management system produces summary reports for the school principal. These reports include global statistics about class performance and schematic histograms showing the dispersion of student levels for each subject where T & P courseware is being used. For a full description of the instructional administration included in these systems see [1].

Reports on the significant impact of this type of computer support on educational gains have been widely published. These important gains are the result of direct effects (students working at a level which is optimal for their cognitive development) and of indirect effects (more individualized teaching methods and better supervision, as a consequence of the management component of the instructional system) [2]. It should not come as a surprise that, if a computer program is able to reach sound pedagogical decisions in its interaction with students on the basis of the information stored in the **student model**, teachers may benefit even more from this same information. In fact, the evolution of the teacher's instructional style, from frontal instruction to a student-tailored approach has been documented in [3]. Another important consideration is that the groups that benefit more from the computer support are precisely those whose needs are less attended to in frontal teaching: the low achievers and the high achievers [4].

6. THE INTEGRATION OF GUIDED AND FREE MODES

The courseware and software items stored in the library are classified in order to facilitate access to them. The classification schema is not UDC or Library of Congress, but rather an *ad hoc* system, conceived in pedagogical terms. Each item is classified in three dimensions: *subject matter, pedagogical intervention* and *school grade*. In the CET library, the main *subject matter* headings are: Mathematics, Hebrew, Foreign Languages, Science and Technology, Humanities, Computers and Applications, and Miscellaneous. These headings are further subdivided into a second classification level. The second dimension, *pedagogical intervention*, is divided into two groups. The first one (guided mode) comprises the entries: Tutorial, Testing, Practice, and Coaching, while the second group (free mode) comprises Simulations, Microworlds, Games, Tools, and Programming Languages. These two dimensions are accessible to teachers and students to respectively assign or select programs. The third dimension, which establishes the application range within the curriculum, assigns a range (initial grade/month, final grade/month) to each instructional program. This information is used by the system **pedagogical model.**

CET's courseware and software library today comprises some 700 titles. It is very difficult for a teacher to assign the more appropriate instructional programs individually, according to each student's progress. By the same token, it is very hard for a student to decide on his own what to select. Our solution was to establish a set of labeled pointers, which connect each topic/level pair within the guided courseware with appropriate instructional units, guided or free, within the whole library. This investment expands considerably the possibilities of the pedagogical model. For instance, if a student is experiencing difficulties while practicing a certain subtopic (detected by a lack of expected progress), the pedagogical model may suggest to the student to study a certain tutorial unit; when a certain level is reached, the pedagogical model may suggest playing a certain instructional game, which may reinforce the concepts being studied, or to run a simulation to develop a more concrete grasp of the reality being studied. In fact, the benefit is felt by the student starting from the selection stage, because there are two *menu* options: a) open access to all the library items, and b) selected menu, which includes only the teacher and pedagogical model recommendations. A student who could be disoriented when confronted with all the possibilities in the library may confidently select menu option b, and work with instructional materials individually selected for him.

7. A VIEW OF THE FUTURE

We feel that the system presented is a first step in the direction of future educational management systems, where the combination of rich student models with well-defined libraries of instructional materials (including the prerequisite relations among them) will allow for an individually tailored definition of each student's instructional path, while also allowing for the dynamic assignment of tasks to groups of students whose cognitive trajectories are compatible at a given moment in time. This system would allow for the optimal development of the cognitive and social capabilities of all the students, while avoiding the pitfalls of rigid classification schema, which ignore the students' needs in order to protect the inertia of present educational systems. Under the false pretense of defending an unreal "equality" between

children, the present system is hurting both the more able and the less able students, and the crisis of educational systems all over the world should be enough to make us reconsider what we have been doing to children.

As Einstein said: "The level of thinking that got us into this mess is not the level of thinking that will get us out."

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