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Programmed Learning & Hypertext

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Programmed Learning & Hypertext

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Abstract. The history of programmed learning and its main principles. The advantages and disadvantages of programmed learning and hypertext systems. The integration of programmed learning and hypertext. The proposal, structure and realization of an electronic textbook. The main advantages of such a textbook.

1 Introduction

The aim of this work is to hint at some contemporary teaching tools and computers for teaching purposes, to minimize charges for educational material and improve the efficiency of the teaching process.

Programmed learning and hypertext are two ways of how to relay information. The former is a teaching method which was developed in the United States in 1960s and was intended to serve for purely pedagogical purposes. On the contrary, hypertext is quite a new way of presenting information. Both of them have their positive and negative qualities.

The integration of programmed learning and hypertext may be used in realizing a new teaching tool - electronic textbooks. One of them, "Architecture of Computers PC," can serve as a classical hypertext system for readers who do not want to systematically study the given sphere and it includes teaching programs which can help students to understand the given stuff.

2 Programmed Learning

The beginning of programmed learning is very often associated with the names of B. F. Skinner and L. S. Pressey. In 1954, psychology professor B. F. Skinner read a lecture about learning and the art of learning. Co-founder of programmed learning, psychology professor L. S. Pressey, built a testing machine to objectively testing intelligence and found that his machine did not only test it, but also learned the stuff. His original testing machine was already built in 1920, but this discovery did not meet much use in his time. In 1960s, Skinner came to the conclusion that Pressey's machines might

be used as teaching machines for programmed learning. These machines were one-purpose only, expensive, and hardly programmable. They could hardly be used for the teaching in various fields of knowledge.

In the following years, programmed learning spread from the United States into Europe and later on into the whole world. Besides the United States, among the biggest producers of programmed machines ranked Japan, the United Kingdom, Sweden, and Germany. The progress of programmed learning was met with a contrary opinion of pedagogues and psychologists.

1990s show a huge expansion of computers in all branches of modern life. Computers have been introduced in schools and educational organizations. Computers serve for guaranteeing computer science teaching where the main goal is to understand the operation of computers and the working with some user programs. Computers in schools can be also used as a tool for teaching different subjects. Computers are not only Pressey machines, but can be used as a universal tool which allows the realization of programmed learning in combination with hypertext.

The following basic principles may be mentioned in programmed learning:

- **Small-steps principle**: It consists of a carefully defined sequence of small and elementary steps (frames) linked together each after another one. Skinner characterizes these steps as adequate if the amount of errors, which a student may commit does not exceed a limit of 5 percent.
- **Active-answer principle**: This principle is based on the fact that the student starts to be passive when he is not activated during the teaching process. He stops accepting new information and the teaching process is not effective. This principle stresses the fact that the teaching process is a series of questions, or problem situations. The student has to give an answer in some written form. This learning is considered effective when there are at least 95 percent of correct answers.
- **Fixing principle**: The teaching process runs effectively when the student is immediately familiarized with the scoring of his answer after each step. This means that the stuff has been correctly understood and is knowingly fixed in the student's memory. If the student makes an error, he is immediately warned and returns to the preceding step, analyzes the problem again and identifies the correct answer.
- **One's-own-rhythm principle**: The student may choose his own rhythm when he learns the theme. He advances in the one-after-one pace. He doesn't learn by somebody else's rhythms. This means he doesn't have to learn more quickly than it corresponds to his own mental level. This principle is very suitable for self-learning.

3 The Integration of Programmed Learning and Hypertext

In times of its main expansion, programmed learning could be effected only in the form of programmed textbooks or programmed texts ignoring computers. Computers were exclusively used for scientific calculations and for mass data processing.

Programmed textbooks were connected with several problems when applied. For example, all teaching programs used a complicated system of hiding step-answers or needed a rather lengthy browsing in the textbook. Both the difficulties may be very effectively solved by hypertext, when answers to particular program steps can be reached by activating the hypertext links. The passing through the program may be effectively run in a similar way.

The original Skinner's conception of programmed learning could not effectively cope with the beginning of a program in such a subject where the student was unable to solve his initial program steps on the basis of his introductory knowledge. A big handicap of classical programmed textbooks was the requirement that the student was to browse the book step by step and in the same way acquire new information. The use of such textbooks was not very fruitful for a reader with preliminary knowledge, who wanted to find some specific information.

However, programmed learning has its indisputable advantages, and its basic principles may also today find a useful application in modern computers. Hypertext utilization may eliminate the aforesaid difficulties.

4 Electronic Textbook

Talking into account what was mentioned above, we may propose the following construction of electronic textbooks. First of all, it is necessary to keep in mind that a hypertext system is very suitable for searching for additional information. If a reader knows certain information in a given sphere of study and only wants its completion, hypertext provides the optimum possibility for its realization, because the information access is quicker than it is the case in a traditional book.

This property is very useful, but it does not suffice in the moment when a reader/student does not have enough knowledge in the field or is ignorant in it. In most cases hypertext systems are built as a huge set of linked nodes, and there is not any recommended or preferred sequence of their reading. It takes much time, before a student finds a good orientation in such a system and gains an initial set of knowledge. The optimal advance may be also difficult for the teacher himself, and it requires long and accurate preparations for the teaching.

The student does not always have a viable access to the computer and we should bear in mind that reading from a monitor screen is slower than that from a traditional book. So, it is sometimes necessary to print the hypertext system. The printing of a hypertext system requires its transformation into a linear form. In case of an unsuitably created hypertext system, this task can be very difficult or even impossible.

An electronic textbook which is realized as an hypertext system, tries to keep both the advantage of hypertext systems combined with the properties of a traditional textbook. The advantages of programmed learning are unquestionable, and its preferences are not diminished for a reader who wants to use the system as a familiar book.

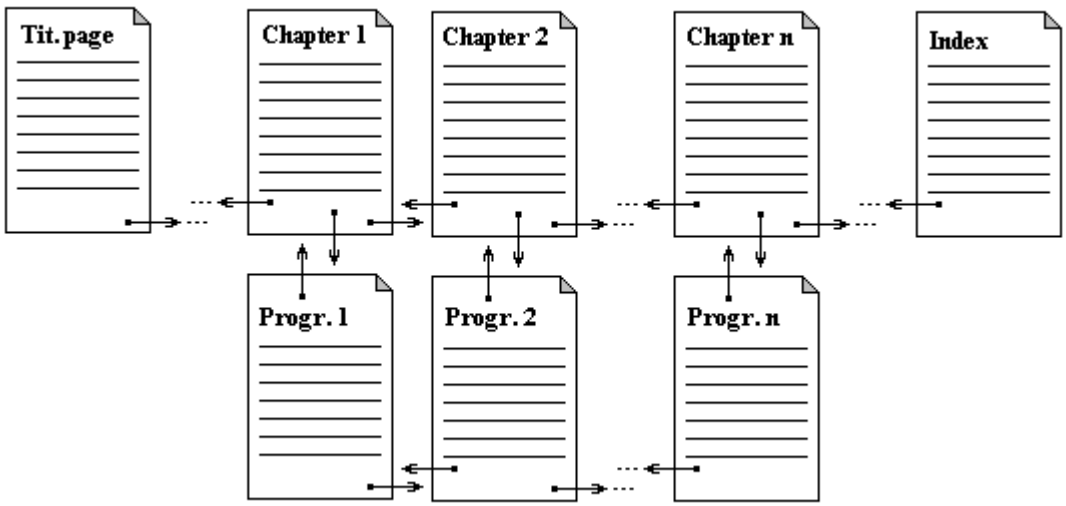

Fig. 1: Basic structure of electronic textbook

An electronic textbook, which can serve as one of the teaching tools in a modern teaching process, is structured in two levels.

- **Hypertext system**: The system provided with the common cross links (not figured in the picture) is also linked with the nodes each of which (excepting the first and last one) is linked with the previous and the next one. These links determine a recommended order of reading and correspond to common browsing in a book. The order of nodes on this level corresponds to the sequence of chapters in a familiar book. This means the electronic textbook begins with the title page (Contents, Introduction) followed by the corresponding chapters. There is an index at the end.
- **Teaching programs**: It is sequence of hypertext nodes where each of them contains the teaching program for a given chapter. Each chapter which has a teaching

program, also has a cross link to this program, and vice versa. The program includes a link providing an easy return to the corresponding chapter.

This solution a of hypertext textbook allows several possibilities of work. It depends only on the reader which possibility he chooses (in the self-learning situation), or on the teacher (in a teaching process).

An introductory explanation of the theme is recommended. Teaching programs explain the stuff in the same sequence as it is the case with each corresponding chapter. This approach does not consider the fact that, during the first steps, the student does not have any input knowledge. We may suppose that after the explanation of the text and a careful reading of the corresponding chapter, the student already has some knowledge. The program serves as a suitable tool for the verification of his understanding. If he finds that some of his answers are wrong he can quickly go back in the text and study the corresponding problem again.

The programs are separated from chapters on another level. So, such a publication may also be used by readers who do not study this field and are not interested in an active going through all the teaching programs. As the textbook contains plenty of various cross links to other nodes, quick access to other concrete information has also been preserved. It is characteristic for current hypertext systems.

Electronic textbooks respecting this model, make quick actualization possible. Such an actualization is especially profitable and necessary in the fields registering a very fast development.

5 Realization of an Electronic Textbook

Let us take the electronic textbook realized in HTML, because its specification is freely accessible, and HTML is not a very complex language. This means that everyone can easily understand and use this language. It also allows the adjusting of such a textbook by the teacher who does not want to teach all the chapters or who wants to insert something to his explanation not included in the book. Programs for browsing the HTML documents (Netscape Communicator, MS Internet Explorer) exist for all massively used platforms (PC, Apple MacIntosh, Sun, SGI, HP, etc.) and operating systems (MS-Windows, MacOS, UNIX).

HTML itself provides a tool strong enough for creating textbooks which include text, pictures and cross links. Its possibilities can be enlarged by using Java Applets which allow playing of sound or video recordings, and a better interaction with the reader much more. If we use these elements, it is necessary to keep in mind that they can exist only in electronic form which prevents their printing.

Economic questions are also very important. Traditional books are very expensive, and schools cannot buy expert publications for whole classes. This situation is even more critical if a publication in question is quickly getting older (or sold out). A good electronic textbook may be considered to be a suitable solution. It can be easily provided by Internet. The teacher can download the last version of the book before the beginning of the school year, and then he can immediately start teaching. The students can find an easy access to this book via the local school-network. The form of this textbook allows easy printing. If necessary, the book or its parts can be printed, and thus the students may be easily provided with them. If the school has no access to Internet, it is possible to distribute needed texts on a CD-ROM. This CD-ROM, or its local copy can be also shared by a local network.

An electronic textbook called "Architecture of Computers PC" was written as an example of such a textbook. It serves as the main educational material for classes called "Personal Computers" and "Architecture of Computers". The access to the just cited textbook may be found on the address:

http://www.fi.muni.cz/usr/pelikan/ARCHIT/TITLE.HTML

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