

PROPOSAL FOR A DISTANCE LEARNING SYSTEM INCORPORATING CHECKS ON STUDENTS' KNOWLEDGE

Dariusz Put

ABSTRACT

The teaching process comprises two main, complementary aspects: providing students with information, and testing both knowledge of this information and acquired skills. The information may fall into two main categories: information that students are expected to learn and remember, and explained problems that students are expected to understand. Testing methods may also be designed in various ways and must take into consideration the nature of the subject. They may constitute part of the teaching system or be separate processes serving as final verification of students' knowledge. The teaching system may be static and present the same information to all participants, or dynamic – the information presented is individualised and depends on students progress. The dynamic process may take two forms: students decide what to study or the system decides which part should be presented. In the second method, the system must include tests checking progress, and depending on the outcome, select a suitable portion of material and steer the learning process individually. The paper provides an analysis of various aspects of distance learning systems. It discusses how knowledge is provided and tested. The last part of the paper contains a concept for an intelligent distance learning system.

KEYWORDS

Distance learning, partial tests, final tests, types of knowledge, interactive cooperation

INTRODUCTION

As computer networks, especially the Internet, have developed, so have the possibilities to take advantage of this technology in the teaching process. Traditional teaching systems may be now assisted, or in some situations even transformed, by a distance learning system in which knowledge is available on the Internet, which is theoretically accessible all over the world.

The information and skills that students are required to learn can be divided into four types:

- Given knowledge – information that students must learn, not necessarily understand (at least this aspect is not decisive). This type of knowledge is presented mainly in a traditional way, during lectures, where a teacher talks and students listen;
- Explained knowledge – information that students must understand, and hence teaching material often needs to be supported by practical examples. Traditionally, this kind of knowledge is delivered during lectures and practical classes, and sometimes various materials and/or laboratory equipment is required;
- Knowledge acquired during discussion and exchange of views – students discuss under the teacher's supervision and in this way share knowledge and practical experience. The discussion must be preceded by students preparation, which may involve studying literature or attending lectures;
- Practical skills – the ability to solve a given problem using materials and laboratory equipment. This kind of knowledge is obtained mainly in laboratory conditions.

In the first type – given knowledge – the teaching process may be fully automated. Lectures and textbooks may be successfully replaced by a well prepared distance learning system. In the second case

full automation is also possible, but the teacher must pay special attention to the way the information is presented and include various ways of presenting the same material. After a unit of information is explained, the system must verify the acquired skills and on the basis of the outcome of this verification it should either move on to the next unit of information or return to the material already presented and present it in more detail. The third type of knowledge may be supported by a distance learning system – students assimilate information prepared by the teacher and then they communicate online and share this knowledge and their experiences, learning new things and reinforcing existing knowledge. In terms of acquiring practical experience, distance learning systems may only support the teaching process by providing students with theoretical preparation. Application of the knowledge acquired in this way must be verified in real conditions using the necessary materials and equipment and under a teacher's supervision.

Existing distance learning systems may be divided into three groups:

- Asynchronous systems, in which there is no direct interaction between participants: among students, or between students and a teacher;
- Synchronous systems, in which the teaching process is interactive, similarly to traditional classes – participants are connected by a computer network and discuss in real time. The main difference between this system and the traditional one is that students are physically in different places. What should be emphasized is that in such a system the use of multimedia is almost always crucial, which means that the quality of the computer systems used by participants and the capacity of the computer network must be sufficient;
- Hybrid systems, which are a kind of combination between synchronous and asynchronous systems.

The traditional teaching system, based on oral lectures, content published in textbooks and laboratory classes, does not allow content to be diversified for individual student. Yet there are a great number of disciplines in which diversity in the knowledge, practical experience and preparation of students are significant, and taking a lecture or class with such a group of students is difficult: the teacher does not know how many students are really interested in the subject and how many are familiar with the issue under discussion. A properly constructed distance learning system facilitates the customisation of the information presented to the knowledge, abilities and skills of each individual student.

FEATURES AND COMPONENTS OF A DISTANCE LEARNING SYSTEM

When embarking on designing a distance learning system it is important to take into consideration the usefulness of its application, paying special attention to:

- flexibility, i.e. the facility to use the system to present various kinds of information, so that it can be used by teachers in a range of disciplines;
- the potential number of students using the system – design, implementation, launch and maintenance require significant outlay; the system has to be used by a considerable number of students and for at least a certain period of time;
- preparation of content by teachers – the best system is useless if it is not filled with carefully prepared knowledge and revision tests;
- hardware and software access – the system has to be widely accessible, and written in a program and on a computer platform facilitating the creation of the necessary database and the management of the data stored in it.

Among asynchronous systems, which are the main components of distance learning systems, the following can be distinguished:

- static systems – the sequence of presentation of the information is chosen by the user or is delivered in a fixed order;
- dynamic systems – the order of units of information is chosen automatically by the system; the decision is taken on the basis of results of tests that students take just after the presentation of a given unit of information.

In dynamic systems knowledge is divided into hierarchically connected segments. To obtain access to information in the next segment, a student has to pass a test on the information in the previous part. The questions in these unit tests are connected with the information database: a wrong answer generates the fragment of information explaining the problem dealt with by the question. Crucial to the success of the whole undertaking is the correct preparation of the information, unit tests, and the necessary connections between them.

Static systems are easier to design, implement and maintain, but are less attractive and may lead to boredom (some students may conclude that they are familiar with a given section of information and before they reach a new part may become discouraged). Dynamic systems are more attractive in this respect, because they provide:

- Automatic control of the teaching process, which guarantees that students will not omit any area of knowledge and will not move on to the next part unless they pass the test relating to the relevant segment;
- Presentation of information in segments, with checks to enable students to pass over individual segments if they are convinced that they are familiar with the information in it. If not, they may test their knowledge using the prepared tests;
- Adjustable level of detail tailored to the individual student – not every kind of explanation may be equally effective for all students. The intelligent system of presenting information must be equipped with control components and include various methods and degrees of information presentation. Analysis of the result of a unit test may take students back to the unit of information just presented and represent it in a different way and in more detail.

In addition to unit tests, which are useful during the teaching process, the system must also be equipped with a set of final tests, the results of which are taken into consideration by the teacher when grading at the end of the whole teaching process. To ensure the credibility of the mark, final tests must be organised properly. An authentication module consisting of login names and passwords and the constraint that the test must be taken on a specific computer or local area network are not enough. Final tests must be invigilated. One main difficulty with this postulate is the distance between the students' and teachers' places of abode, especially when final tests have to be taken frequently. This problem may be solved by establishing co-operation with a reliable institution (not necessarily a teaching institution) equipped with computers with the Internet access in the vicinity of the students' home.

FACTORS DECISIVE TO SUCCESS

The success of the teaching process depends on a great number of factors. Experiences show that the most permanent knowledge is acquired systematically and revised from time to time. This is why one of the crucial factors in the teaching process is to include useful methods of reinforcing knowledge. Thus, familiarity with the various units of knowledge needs to be checked. Unit tests checking knowledge of a given segment should also include questions on previous segments already passed, and if the given answer is wrong, the part of knowledge connected to the question should be displayed.

Palloffm and Pratt (1999) defined some of the attributes vital to students studying using distance learning systems. One of their distinguishing features is greater self-discipline than the average student has. Thus, the system should force self-discipline, and also regularity. To meet this demand, the unit tests should be a component parts of the system. This forces students to work systematically, because if not, they does not manage to learn all the material on time, because they cannot move on to the next unit of information unless they pass the previous unit test. Students have to keep to a timetable in passing the unit tests, so that the teacher can control the regularity of students' work. The smaller the segments of knowledge and the more often the unit tests are organised, the more systematic the student's work.

The suitability of materials in terms of content is also an aspect of central importance to the success of the system. The teacher interface should allow the teacher to input materials into the system as well as

checking tests and connect them. The materials must be prepared in the correct format, which on the one hand should be user-friendly for teachers, who may not be familiar with IT, and on the other hand must enable teachers to enter data into the database and organise the presentation of knowledge according to their plan.

Asynchronous systems can replace given knowledge entirely. Better results may be achieved by using hybrid systems that facilitate student-teacher and student-student contact. This contact may be on-line – at an established time everybody interested in the subject (including the teacher) connects via the network – or off-line, using discussion lists and/or e-mail.

In summary, the factors crucial to the success of a distance learning system may be divided into two groups:

1. Those related directly to the IT system:

- a properly prepared teacher interface that enables the teacher to enter teaching materials prepared in established formats into the database, connect them appropriately, and include partial and final tests;
- a flexible database system, which must be open (for inclusion of new materials) and allow modification of existing materials, deletion and connection between individual units of information, and between them and the questions included in the unit tests, in order to facilitate display of the information tested in each question;
- interesting presentation using various multimedia techniques adequate to the teaching material;
- easy communication between participants, both on-line and off-line;
- an open system – a dedicated system built only for a specific subject is not sufficiently efficient; the benefits would be not great enough compared to the costs.

2. Those related to the content:

- well prepared, relevant teaching materials;
- teaching materials tailored to students' abilities (not too difficult, accommodating both capable and less capable students, including a range of examples);
- checking modules, which support students and motivate them by demonstrating their progress or lack of it;
- connection between the presentation and checking modules – this facilitates the decision on the type of teaching process to be used;
- the necessity to revise past material should be included.

PROPOSAL FOR A HYBRID DISTANCE LEARNING SYSTEM

The proposed hybrid distance learning system consists of:

- an information database (built as a hypertext);
- a unit test database (connected to the information database);
- a final test database (used for final verification);
- a teacher application (knowledge database editor, test editor, a tool for connecting the information database with the questions in the unit test database);
- a student application (accessible from the Internet);
- a module enabling participants to connect online.

Students log into the system by typing their login name and password. The body of information is divided into separate parts, so the appropriate part for students is chosen. This choice is made in different ways for different students:

- continuity of learning – for students who have connected before and want to continue learning; the presented information starts from the place where student left off after his or her previous session;
- entrance test – for students who log into the system for the first time and want the system to decide which unit of information they should start from; it is selected on the basis of the results of an entrance test;
- students decide what they want to study.

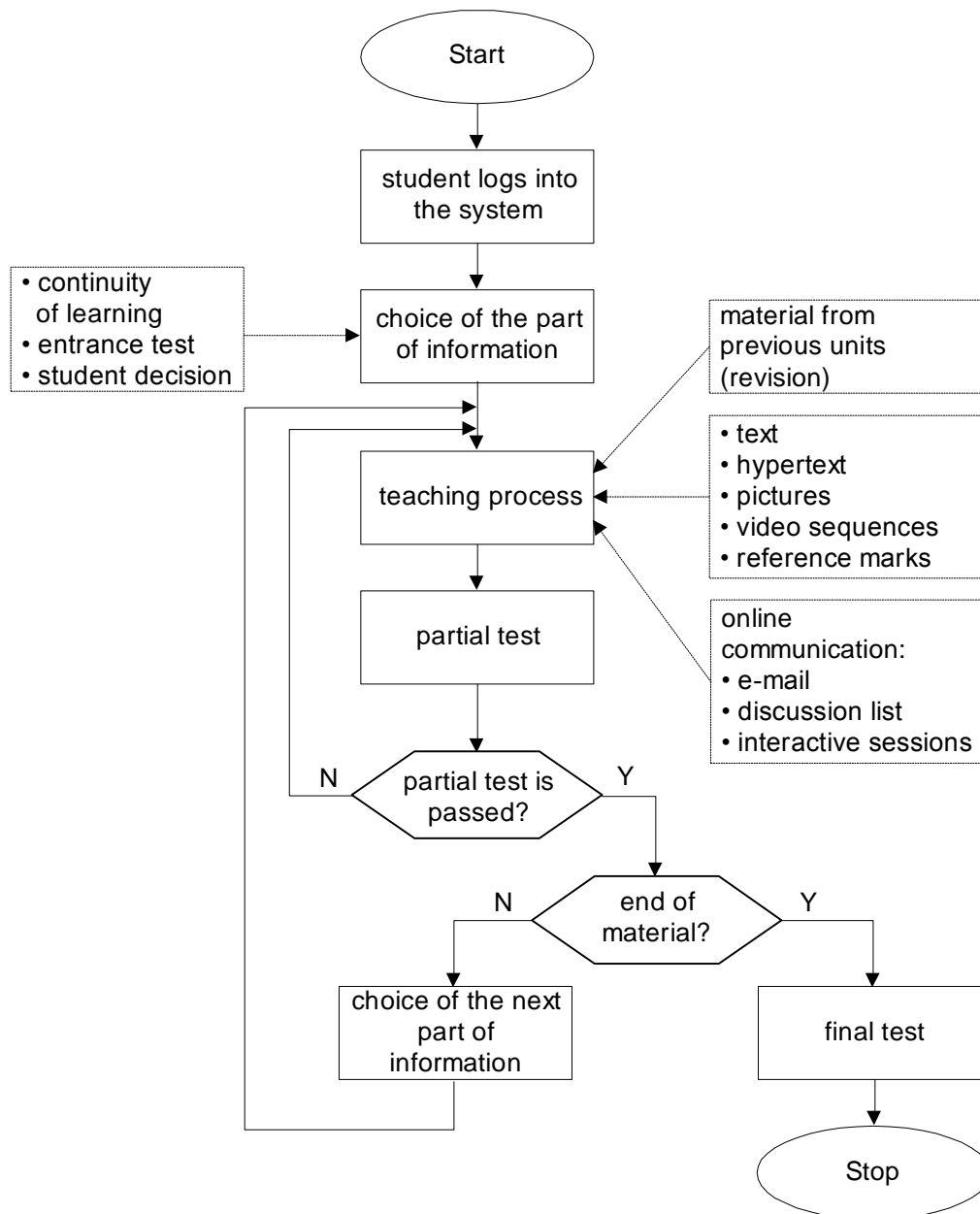


Figure 1. Hybrid distance learning system incorporating checks on students' knowledge

After this selection is made comes the teaching process. Students study using teaching material prepared by a teacher. The material is presented in various forms:

- text;
- hypertext;
- pictures;
- video sequences;
- reference marks that facilitate the display of the same knowledge in various ways.

The teaching process is assisted by a communication system that enables each student to stay in touch with other participants, including the teacher. Students can communicate with each other and with the teacher, and ask questions and exchange views via:

- e-mail;
- discussion list;

- interactive sessions online with the teacher, who at the beginning of the teaching process establishes a set of dates he or she will be accessible on a selected IRC channel.

After acquainting a student with the chosen unit of information, the system initiates a unit test comprised mainly of questions on the teaching material just presented, but also including questions checking knowledge that the student should already have had. Each question is connected with a piece of information, which is presented if the student gives the wrong answer. On the basis of the number of correct answers the system classifies the test as passed or failed. If the student passes the test he or she may proceed to the next teaching segment, which is selected according to an algorithm designed by the teacher. In addition to teaching material belonging to that unit of information, the student also obtains material from previous segments, chosen on the basis of the results of unit tests already passed. Because this additional material is chosen accordingly to individual student progress and the results of unit tests, it is useful for revision. The better the test result, the more rarely previous teaching material is presented in the future. If the student fails a unit test, he or she has to study all the material again, which this time is presented in more detail and using more examples and explanations.

Hence the results of unit tests influence the following:

- the decision as to whether the test is passed or failed, and consequently whether the student knows the section of material;
- the choice of information to be presented in subsequent segments;
- the questions that will be included in the next unit test.

At the end of the teaching period the teacher organises a final test on the basis of which he or she grades the students. This test must be invigilated by a teacher or a reliable cooperating institution. Students take the exam at an appointed time or at a time of their choosing within an appointed period.

CONCLUSION

Distance learning is becoming increasingly popular and is used both by educational institutions (e.g. schools, colleges, education centres) and by other organisations for training their employees. Use of such a system has various advantages, including the following:

- saving of teacher's time (and training expenses),
- reduction of demand for classroom space,
- freedom to study any time and anywhere,
- minimum requirements from the student in terms of equipment and software,
- facility to prepare the topic in an interesting and motivating way.

This paper presented and discussed the hybrid distance learning system incorporating checks on students' knowledge. The process of self-education is supported by contacts with a teacher and between participants. This contact is both synchronous (using an IRC channel) and asynchronous (e-mail, discussion list).

The system has a number of advantages over traditional methods, including:

- the possibility of adjusting the teaching process and speed to individual students' predispositions and abilities;
- automatic control of the didactic process;
- the freedom for the teaching process to take place any time and anywhere;
- automatic verification of knowledge and intelligent choice of material for revision;
- relieving the teacher of the need to present material that students can easily learn individually.

In the teaching process both students and teachers are taught: students gain knowledge and practical skills, while teachers inquire whether the material is presented comprehensibly, and which parts are difficult for students and require special attention to presentation. This information and experience is impossible to achieve without interactive cooperation between students and teachers. Lack of such

cooperation may cause teaching materials to be unsuitable in relation to students' knowledge and skills, which may discourage them from using this form of self-education.

Only experienced teachers are capable of reacting appropriately to problems that arise during the teaching process. This is why computer distance learning systems may only support traditional ones. Undoubtedly this rule does not apply to every kind of knowledge or skills. One example is given knowledge, which may be fully replaced with a well constructed distance learning system. For other kinds of knowledge the issue is more complex.

REFERENCES

Halpin D. M., Scheer S. B., Lockee B. B. (2003). Supporting Distance Learners: The IT Studio Model, *International Journal of Instructional Media*, 30(4), 343–347.

Harasim L. (2000). Shift Happens: Online Education as a New Paradigm in Learning, *Internet & Higher Education*, 3, 41–61.

Levy S. (2003). Six Factors to Consider when Planning Online Distance Learning Programs in Higher Education, *Journal of Distance Learning Administration*, 6(1),
from <http://www.westga.edu/%7Edistance/ojdl/spring61/levy61.htm>

Palloff R. M., Pratt K. (1999). *Building Learning Communities in Cyberspace*, Jossey-Bass Publisher, San Francisco.

Put D., Stal J., Żurowicz M. (1999). *The System of Checking Students' Knowledge with the Use of Wide Area Networks*, Association for Computing Machinery, New York.

Put D., Stal J., Żurowicz M. (1999). *The Use of the Internet in the Teaching Process*, Association for Computing Machinery, New York.

Van der Linden W. J., Glas C. A. W. (2000). *Computerized Adaptive Testing: Theory and Practice*. Kluwer Academic Publishers. New York.

Dariusz Put
Cracow University of Economics
Computer Science Department
27 Rakowicka Str.
31-510 Cracow, Poland
Email: putd@ae.krakow.pl