

ADAPTIVE E-LEARNING

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Abstract

Learning has never been considered an easy process, and it is thus necessary to adjust teaching contents to each individual student in order to facilitate this process. For a long time, attention in learning was paid only to contents transferred to students, while the way in which the contents were transferred was less important. For the purpose of quality education attention must be paid to development of technology, and the very learning process should be adjusted to new technological achievements, i.e. technological innovations should be used for more quality education and professional improvement.

Keywords: e-learning, adaptive learning, adaptive systems, teaching models, LMS systems, learning styles.

INTRODUCTION

A quality knowledge transfer process represents a basis for efficient functioning of the modern society. Due to the constant increase of knowledge volume, it is necessary to constantly innovate the knowledge transfer process, and to improve it for the purpose of efficient production of experts that will be able to answer the future challenges of their profession. The main advantages of all types of distant learning are a better access to teaching contents (on the Internet), unlimited time availability, cost reduction, flexibility of teaching plans and programs, and their better integration in compliance with user needs. [3]

ADAPTABILITY AND ADAPTIVE E-EDUCATION

The term e-learning comes from electronic learning and is frequently identified with the terms web-based learning, online learning or distant learning. However, there are differences among these terms. There are still various discussions regarding the e-learning definition. Thomas Dietinger claims that e-learning represents only one part of the learning process. It must be supplemented with e-teaching, and this process is called e-education. Some authors define e-learning in the following way: "e-learning most frequently associates with activities that include computers and an interactive network. The

computer does not have to be the main element of this activity or provision of learning contents. However, the computer and network must have a significant role in the learning process".

What is adaptive learning?

The learning environment is considered adaptive if it can follow activities of its users; interpret them in main sectors of specific models; make conclusions about user requests and affinities far from interpreted activities, representing them adequately in the said models; and finally, impact its users with the available knowledge and dynamically manage the learning process.

Adaptive e-learning systems

Certain information about users is needed in order to change the system behavior so that the user needs could be satisfied. In adaptive systems this information is saved in the user profile or model. Therefore, a detailed user profile is needed to enable the system adaptability. In the e-learning context, there is also instruction adaptation. Instructions are in the form to which the students are used.

The need for creation of user model and profile

Behavior of an adaptive system varies pursuant to data from the user model and

profile. Without any knowledge about user the system would behave in the completely same way for all users. Koch describes the user model applications in the following way: "Users are different, they have different environments, different knowledge about certain issues, different affinities, aims, interests. In order to individualize and personalize users' actions, we need the user model to allow selection of individual replies to users. [5]"

Therefore, the user model should be applied always when individualized replies by the system are expected. Various application types can benefit from the user model. User models are frequently integral parts of the adaptive system for electronic learning and are tightly connected with the instruction part of such systems. Other applications of user modeling are for instance: searching machines or assistance systems. Not only users' attributes (e.g. knowledge, affinities, aims), but also users' limitations (e.g. incapability to recognize colors, etc.) must be taken into consideration in the user model. If these limitations have to be violated, it is important to know to what extent the disturbance can be reduced.

Knowledge improvement

For the purpose of helping students during the knowledge improvement, intelligent tutor systems (ITS) offer four stadiums. Three of them refer to what they should learn, when they should learn it, and how to learn, while the final stadium is the use of learning activity. [4]

What should be learned: in this stadium, the student model provides information about the students' knowledge domain. The system is interested in students' lack of knowledge. With this information the tutor module is capable of selecting a „curriculum sequence“, to provide urgent assistance and feedback information during the process of problem solving, or to provide "passive" assistance at request. The „curriculum sequence“ is used for offering the most suitable learning sequences to a student. Learning sequences contain series of lessons and examples, questions and problems to be solved. The „curriculum sequence“ helps students to find a

proper way of learning through learning materials. There are two subtypes in the „curriculum sequence“ – high sequence level and low sequence level. The high level of sharing, or knowledge share, uses the student model and the knowledge domain to select successive concepts of teaching or topics. The low level of sharing uses only the student model to determine the next learning topic (e.g. a test or question). [1].

With the use of recorded student behavior, the system can provide active assistance or feedback information. „Smart“ feedback information for offering solutions to students, such as feedback information about mistakes or comparing of students' solutions with the correct solution, helps improving students' knowledge about particular topic. Further on, auxiliary reminders help students during problem solving. Whenever students request help regarding a problem, the system offers them passive knowledge, such as hints, answers to questions or additional explanations that rely on students' knowledge saved in the student model.

When to learn: the right time for improving knowledge is calculated with the use of the student model. This is important when active help during the process of problem solving is needed.

How to learn: the right ways of learning, such as explanations, tests, examples and problems, are selected with the use of the student model. These ways of learning are influenced by learning styles or affinities saved in the student model.

Implementation of learning procedures: in this stadium some learning procedures may be modified on the basis of the student model. For example, if a student has higher level of knowledge about a topic, there are fewer explanations for problem solving.

Personalization based on learning styles

A learning style is the preferred way of thinking, procession and understanding of information. Learning styles represent a description of views and behaviors that determine our affinities in learning. [6]

The main four styles was proposed first by David Kolb, as far back as 1984. According to him, there are:

1. activists,
2. thinkers,
3. theoreticians,
4. pragmatics.

This model is based on a four-level learning process in which:

1. direct and actual experiences offer a basis for
2. observing and reflecting (thinking) that are distilled into
3. abstract concepts, producing new implications for action that can be
4. actively tested, producing new experiences.

In simple words, the first stage of this learning cycle is acquisition of new experiences, the second comprises observing and thinking about these experiences, the third stage is connecting of these experiences with a wider student's knowledge basis, while the fourth stage implies the use of these experiences and acquisition of new ones.

This connection between the learning styles and steps-stages in the learning process implies that those people who, for instance, prefer acquisition of direct and concrete experiences will have pronounced first stage of learning, and they will go through other stages rapidly and superficially. In fact, most people prefer two or more learning styles, and seldom only one. Quality learning implies equal dedication to all of the said learning stages. It means that learning methods referring to each of the said learning styles must be applied in the learning process. [7]

ADAPTATION IN LMS SYSTEMS

When we speak about e-learning, we should mention two key terms: contents and management system. The management system is a generic software application that is also called Learning Management System (LMS), which above all enables the user to apply e-learning, i.e. to attend online courses, seminars and other educational contents. Advantages of e-learning are the following:

1. enables selection of the place, time and duration of individual learning sessions,
2. enables access to distant users for whom it is too expensive to travel, and
3. enables financially acceptable training for large systems, with dislocated training for a large number of system users.

E-learning includes a lot of different technologies and ways of communication between students and teachers, which we can present as three types of e-learning:

1. Electronic learning performed in a classroom in which students and the teacher are present. There are developed programs, the so-called „classroom aid” – some of them are used for presentation of material without interaction, while others are used with interaction, e.g. programmed tests; the third can include control of student computers' operation.

2. Individual use of prepared materials performed in another location. In this type of electronic learning materials are delivered to students on a CD-ROM or another similar medium, or students use them on the Internet. This type of learning is a supplement to classic teaching performed in a classroom, and in literature it is called “blended learning” or “mixed mode”.

3. The entire learning process is designed to be carried out on the Internet, which makes e-learning one of distant learning forms. The Internet has solved the problem of communication between the institution and students, as well as material distribution, in a comfortable way. Institutions and students accepted this solution as the one of modern age.

EDUCATIONAL MODEL

Educational model represents the main reflection of the system regarding the target user, student, providing necessary information for adjusting instructions to the needs of users. This necessary information is presented by contents of the learning model. The entire contents can be grouped pursuant to the needs of students. These groups are sorted according to the learning model components.

Contents of educational models

A comprehensive educational model should contain information about the student's knowledge domain, his progress, affinities, aims, interests and other information needed for the used systems. John Self and Peter Brusilovsky state that educational models can be sorted according to the nature and form of information they contain. Having in mind the

domain subject, the information saved in the educational model can be divided into two main groups: the domain of specific information and the domain of independent information. The domain of specific information represents a reflection of the student's status and knowledge level, and particular skills within the actual subject. Brusilovsky refers to the domain of specific information as the model of specific information knowledge. The educational model can be based on various types of models or can be a combination of them. In regard to that, the following educational models can be named:

Scalar model: Within the scalar model, the level of student's knowledge in relation to the entire model is determined through one identifier, such as a number from 1 to 5. The scalar model is the simplest form of the knowledge model that does not provide information from the sub-domain.

Additional model: The entire information domain consists of a group of cognitive elements or curriculum elements, representing expert knowledge within the domain. The additional model defines students' knowledge as a subgroup of the entire domain model. A lack of students' knowledge is based on comparison with expert knowledge. In relation to each knowledge element within the model, a measure has been defined, and it represents the estimated student's knowledge about that element. The measure can be a scalar (e.g. number, probability measure) or vector estimation. [4].

Bag model: This model has been developed on the basis of a lack of additional model, and it stored mistakes made by students. Within the bag model it is possible to define and reflect students' wrong actions, as well as reasons for these mistakes. The bag model can be categorized into models of changing places or differential models. Misconception for each knowledge element is saved in the misconception model. The assumption is that there is one or several misconceptions for each knowledge element in the domain model. Therefore, misconception of the educational model represents a subgroup of all possible misconceptions that cause irregular behaviour

of students regarding particular knowledge element. [2].

Genetic model: The bag model reflects the status of a student's knowledge, but this model does not show the structure of the domain knowledge, and for that reason the genetic model is used to show development of student's knowledge. This procedure can be developed from simple to complex or from particular to general. For example, a student starts with particular knowledge and continues to wide and general knowledge. The genetic model can be described with the use of a genetic graph, where knots and connections between them represent knowledge elements and their interactions. [4]

Other specific domain information: Besides already mentioned specific domain information that is saved in various model types, additional specific information can be saved in the learning model. According to Binglan Han, this information includes:

1. student's former knowledge about the domain;
2. records on learning activities (attending classes, the number of requests for assistance, the time needed for problem solving), and
3. records on marks or knowledge evaluation.

Generally observing, the additional domain of specific information can contain necessary information for specific purposes of the educational model that is related to the domain subject.

Domain independent information: In compliance with the current level of student's knowledge, domain independent information is necessary to enable adaptability. The domain independent information about a student can include the aims of learning, cognitive preferences, motivation conditions, former knowledge and experiences, affinities, as well as actual and historical data.

Aims: In order to determine the right teaching strategy it is necessary to know students' aims. These aims can show why students use the e-learning system and what they want to accomplish by that. The aims can be divided into various types: the first type is the aim of learning and it is stable during the teaching unit; the second is the aim of problem solving that can be changed from one to another problem even within one teaching

unit. An example of the aims of learning is the intention to pass an exam or to solve particular problem. [4]

Cognitive preferences: Cognitive preferences are intellectual skills for various types of cognitive performance. Musical preferences or preference for mathematics or reading are examples of various cognitive preferences.

Motivation conditions: Students' motivation conditions are used for determining the effect of instructions. Motivation can be measured with the use of long-term and short-term parameters, such as efforts, attention, interest, absent-mindedness, persistence, etc. These parameters are connected to other factors such as the knowledge level, students' being well-read, the issue complexity and educational result.

Behrouz Homayoun Far and A.H.Hasimoto propose a learning model that takes into consideration students' motivation and their educational status. Within this learning model, the motivation condition is represented through Bayes' network, where the graph discovers dependence between the motivation component and learning activity. For example, the way from absent-mindedness to concentration shows that students' absent-mindedness influences their attention..

Former education and experience: Information regarding students' former knowledge and experience are used for the purpose of defining parameters of the learning model. The former education includes all skills that can influence success in learning. Such information is, for instance, occupation, working experience, future plans. [1]. Experience represents knowledge in relation to the educational environment. A student that is not familiar with particular educational environment or e-learning can have a different support system regardless of whether he is a beginner or expert in the given field. This information can be useful for the purpose of selecting the right adaptive navigation method.

Affinities: Students may have different affinities regarding certain aspects of the educational environment. These affinities are not considered to be caused by the system, and a student thus has to inform the system,

directly or indirectly, about his/her affinities. It is very important that the adaptive e-learning system presents and organizes the learning material pursuant to the student's affinities. Students' affinities can be used for creating a group of students. This technique is called "group modeling", where the group is made of students with the same affinities. The two elements of preference are: learning style and multiple intelligence, which are mutually connected.

Huard Gardner was the first to describe the multiple intelligence theory in 1983. His recent research shows that there are eight different forms of intelligence: linguistic, logical-mathematical, spatial, kinetic, musical, interpersonal, intrapersonal, and natural intelligence. [4]. Gardner states that all people possess all the eight forms of intelligence, but to different extents. Having in mind multiple intelligence during the adaptation process, educational environment can adjust the learning material according to students' potential, which enables the process to remain at the highest level.

Actual and historical data: Demographic data, such as name, age, parents, personal data and so on, are stored within the educational model. This information combined pursuant to other actual data, such as interests, is needed for initiation of the individual learning model.

With the aim of completeness of information about a student, Yujian Zhou and Martha W. Evens state two additional components: historical files and solution files (answers). A student's historical files is attached to each instruction unit, storing information about the studied material, as well as the student's answers during the teaching unit. The percentage of mistakes and descriptions of mistakes made during problem solving are located in the answer files.

Another approach to segmentation of the learning model consists of several components described by Gladys Castillo, where the learning model is divided into three components: profile, cognitive additional model, and additional course model. A student's profile contains information such as name, age, learning style, etc. The picture created by the system regarding the student's knowledge is saved in the cognitive-additional

component, while the course additional model provides information referring to interactions with the system. [4]

CONCLUSION

The present period is characterized by constant changes, and it is thus necessary to improve one's knowledge constantly in order to achieve competitiveness in the market. Learning is a complex process through which we acquire different knowledge and skills, discover our own capabilities and learn about our views, values and feelings.

If we take into consideration the fact that knowledge rapidly becomes out-of-date, it is needed to accelerate the very learning process, i.e. to consider the use of computers and Internet an integral part of knowledge transfer.

Each student should be approached individually, and we should understand their nature, habits and preferences. Besides the ways in which knowledge is transferred to students, it is also very important to teach students when they should study, what they should learn, how they should study and finally apply learning activities.

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