

# STUDENT MODEL DEVELOPMENT FOR E-LEARNING SYSTEMS

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## ABSTRACT

The paper studies the user model development problem for computer-aided teaching systems. Main steps and aspects of the user modeling process are outlined. The most important facets for models' implementation are the aim, user functions, general information, experience in computer-based systems employ and psychological characteristics. The student model for adaptive computer-aided teaching is offered. It consists of five main parameters' groups: general information, background knowledge, current work with a course, teaching method/strategy and psychological characteristics.

## KEYWORDS

Computer-based systems, adaptation, student model

## 1. INTRODUCTION

Nowadays many different institutions use intelligent interactive systems. To develop such kind of systems various aspects should be taken into account: system architecture, user models, implementation tools, validation and verification tools, etc. Usually all of these facets are considered in some or another way, but more attention is paid just to "practical" side of the interactive systems realization. Developers try to work out many functions that excite user, they employ modern technologies that make system more powerful, but in many cases user modeling aspect isn't observed enough to implement appropriate and effective intelligent system.

## 2. USER MODEL'S DEVELOPMENT

One of the most important steps for intelligent interactive systems development is user modeling. It helps to define user needs, abilities and other characteristics. The main facets that influence the system reaction on user activities are as follows:

- an aim of a system;
- user (user group) functions in a system;
- general information about a definite user;
- a working process with a system;
- individual user psychological characteristics.

The first question to solve in every system development is to define an *aim* of it. The aim actually helps to determine user groups that will work with it, the information that will be gathered and kept about each of the groups and information that will be shown to the user.

When the aim is defined the exact *functions* that will be available for each user group are described. At this step the detailed input and output data is appointed that is essential for functions realization.

After determining the user groups it is necessary to find out what data is needed about each of them. For some just *general information* is enough. General information may include such data as specialty, experience in working with computer-aided systems, etc.

To make system more interactive and intelligent the developers should take into account a *working process* – what was the user last activity, what problems arose, what are the results of the last step, etc. This information helps system to define the next step, what kind of information to give to a user next.

*Psychological characteristics* mostly influence the interface: information representation way, time for definite activity and other.

In case of computer-aided teaching system (CATS) the aim is to ease and improve the teaching process. Such kind of systems help tutor to organize it in more appropriate and effective way, prepared learning objects can be used and reused, for students it allows to learn at suitable time and place.

Taking into account the defined aim at least five main groups should be provided in CATS: student, tutor, teaching material (learning objects) author, operator and administrator [1].

*Administrator* should be able to provide a correct work of a whole system, users registering, user's information modification and so on. *Operator* has to ensure such a function as disconnecting those users, who doesn't work with a system for a long time interval after connection.

*Tutor* operations are as following: determine different courses and tasks for a certain group; review information about each student or a whole group work and success; debate (communicate via e-mail or forums/chat) with students; modify existing courses (add tasks or teaching information); define lessons' teaching methods and control parameters (answering time type and approach, dialogue scenario, etc.).

Learning objects' *author* should: develop new course; test and debug an existing course; modify an existing course; work out a model of a course; determine teaching scenario; prepare annotation and methodical information for a course, as well as information about course (about tasks, tests and topics).

*Student* can get teaching information, perform different tasks determined by a tutor, look through own progress, results, discuss various questions with a tutor and other students, etc.

The main actor for CATS is a student. Therefore more detailed research is made for this user group.

### 3. STUDENT MODEL FOR ADAPTIVE TEACHING

To organize a teaching process in the most appropriate way (taking into account adaptivity and adaptability features) with afore mentioned aspects of user modeling some additional components should be included for students such as background knowledge and teaching method/strategy.

The general information that describes a student is educational programme, specialty, experience in working with intelligent systems, etc.

To provide adaptive navigating in CATS student work with a course (a system) should be retraced, so that the system could know where to go next – either it will be the next learning information or the task, or just annotation for some part of a course and so on. That's why it is useful to include to the student model such data as how much time student needs to acquire new 'stuff', how many times he/she asked for detailed explanation or repetition, how many mistakes were made, etc. Moreover the current work can be divided into two subgroups – for theoretical information and for practical exercises.

Psychological characteristics influences first of all the dialogue organization – the way to represent information, tasks formulating, timing for new material acquisition and for consecutive exercise and other operations concerning dialogue itself.

So, more formal student model is shown in (1)

$$M_{st} = \{M_{gi}, M_{bk}, M_w, M_{tm}, M_{pc}\}, \quad (1)$$

where  $M_{gi}$  – general information about student;

$M_{bk}$  – background knowledge;

$M_w$  – work with a course (a system);

$M_{tm}$  – teaching method or/and strategy;

$M_{pc}$  – psychological characteristics.

Thus, the student model for adaptive teaching consists of five main components that include various parameters [2]. The components and their parameters are shown in Table 1.

Table 1. Student model for adaptive teaching

Component	Parameter
General information	Educational programme (EP) Specialty (S) Experience in working with computer systems (Exp <sub>1</sub> ) Experience in working with CATS (Exp <sub>2</sub> )
Background knowledge	Knowledge level (Kl) Skills level (Sl)
Work with a course	Teaching information: Recourse (R); Detailed explanation (DE); Examples (E); Speed (S) (Timing) Practical tasks: Number of mistakes (Mist); Tasks difficulty (D); Number of tries (Try); Mark (M)
Teaching method	Method/strategy (can be a combination)
Psychological characteristics	Memory type (MT) (audio, video, causal) Orientation (O) (on task, on him-/herself, on collaboration) Learning ability (LA) Learning style (LS)

As it can be seen from parameters list all the components of the student model have different structure:

$M_{gi}$  – general information about student is a vector with four elements {EP, S, Exp<sub>1</sub>, Exp<sub>2</sub>};

$M_{bk}$  – background knowledge also is a vector {Kl, Sl}, but in some cases if there is essential to have data about background knowledge in different subjects then it is a graph, which vertexes are vectors with two elements {Kl, Sl} and ages are connections between courses (or course atoms);

$M_w$  – work with a course (a system) is a graph actually based on a course model and here vertexes are also vectors with 9 elements {LO<sub>i</sub>, R, DE, E, S, Mist, D, Try, M}, where LO<sub>i</sub> is an index of learning object of the definite course and other elements are parameters of this component;

$M_{tm}$  – teaching method or/and strategy could be as scalar as vector;

$M_{pc}$  – psychological characteristics is a vector with 4 elements {MT, O, LA, LS}.

Offered student model was developed at Riga Technical University and includes all the essential information about a student to organize adaptive teaching. The most part of existing student models include either something similar to Work with a course or Knowledge level. But it's not enough for more adaptive and more effective teaching [3, 4].

## 4. CONCLUSIONS

Developing interactive intelligent system user modeling problem should be considered. Usually such kind of systems include just general information about a user. The main aspects that have to be overviewed are system's aim, user functions, general information about a user, work with a system and psychological characteristics. In case of computer-aided teaching systems a student model is the most important. The offered student model for adaptive teaching has 5 components: general information, background knowledge, work with a course, teaching method and psychological characteristics.

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