



ADAPTIVE FORM OF ELEARNING

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Abstract

Among classic and electronic forms of education, a new type is being considered – the individualised form of education. The main reasoning behind individualised education is to respect differences of individual students. This individualised form of education in connection with the ever-present ICT devices leads to a new form of education – adaptive eLearning: a form of educational process that is in harmony with individual needs of students. This article deals with the basic principles of creating adaptive learning environment; with the current conditions of this issue in the Czech Republic and abroad; and with the outline of possible solutions to the adaptive electronic teaching process. In the second half of the article, the structure of adaptive study aids is described in detail.

Keywords

learning style, teaching style, virtual teacher, learning framework and layers

A Little Excursion into History of eLearning

Towards the end of the last century, eLearning has become a new modern trend in education. The development and definition of eLearning has been shaped by the struggle between the pedagogical and the technological approach to eLearning and the development of new technologies. Most authors agree that the basis of eLearning can be seen in the computer based training (CBT) – utilising computer and managed (programmed) teaching with the use of multimedia. What can be said about that period, from today’s perspective, is that it did not have the characteristic „study anytime, anywhere“ flavour. This type is still prominent nowadays with the significant development of multimedia.

Year 1999 is connected with the „birth“ of eLearning in the sense of LMS = learning management system, which enables distribution of various courses through the web, with the well known „anytime, anywhere“ concept of education, also known as 24/7/365, i.e. 24 hours a day, 7 days a week, all year long! The LMS brings forth completely new ways of administration and help to students, teachers and administrators.

Current LMSs are being constantly improved, which, together with the development of hardware, software and even the internet, shows a bright future for eLearning. Pedagogical approach, which has become more prominent since 2002, together with professional management and blended learning, as well as unequivocally positive results of some

universities and companies, these all show that eLearning has its advantages and can be effective not only for distant and combined forms of studies, but for full-time studies as well.

Need for New Forms of Teaching

The educational process is currently being more and more affected by new technologies and new pedagogical & psychological approaches. In today's information society, new ever increasing requirements are being created constantly for improving the educational process. At the same time, the need for and necessity of long-life learning is rising. Requirements put on teachers are gradually transforming; according to modern experts, teachers should become „guides“ through education and empathetic partners to students. Their role is shifting from former directive status „closer to students“. Use of modern methods in education is therefore expected more than ever.

eLearning is utilised in many ways, from the simplest form of providing students with study materials on the web or in electronic form in PDF format to using modern applications that manage teaching and many related activities of both the teacher and student (LMS). Student can take either passive or active role. For the time being, students cannot really impact the teaching process of which they are part of. Published works provide various recommendations, rules or theories that aim to make learning better and easier. This generalisation, however, suppresses the individuality of students. Known and used theories are often based only on already gained knowledge of students and do not take into account their individual learning characteristics and needs, the use of which would help them to understand the subject matter better and more effectively (Mareš, 1998).

In traditional education, teacher teaches all students in the same way. Even though they are aware that each student is a unique individual (has their own preferences, input knowledge, learning style, etc.), it is not possible to approach every student individually during classes. Teachers can only adapt their teaching to accommodate the majority of their students. Different situation arises when the teacher or tutor and the students are not in direct contact, i.e. face-to-face. In such a scenario, teacher must prepare all study materials and organisational guidelines for students in order for them to have minimal problems while going through their studies. This form of education is nowadays most frequently organised with LMSs. This form is called the eLearning education managed by the LMS.

Yet not even this form provides teaching approach that would be adapted to the specificity of each individual. Subject matter is provided in a unified compact form with precisely planned milestones throughout the course. This path is not suitable for everybody. Modern information and communication technologies, the possibilities of vast databases, multimedia tools, the internet and other means for the individualisation of studies make the individualisation possible.

Current situation

Foreign solving of the issue of adaptive learning is fairly frequent, but not always complex enough from the pedagogical-psychological-informatical viewpoint. We introduce the newest researches done in this field, and summarise some of the results later on that will be taken into consideration during our own research.

Peter Brusilovsky has been dealing with the issues of adaptive systems for more than 20 years. He has published several works and edited a few books on adaptive hypermedia and adaptive web. Bibliographic search of his work will be the basis for orienting in adaptive systems.

Brusilovsky published an article called *Methods and Techniques of Adaptive Hypermedia* that summarises that time knowledge of adaptive hypermedia (AH), and adaptive systems created up till then. In order for a system to be called adaptive, it needs to be hypertextual and hypermedial, it should have a user model and should be able to adapt hypermedia according to this model. Adaptive techniques have been divided by Brusilovsky to adaptive navigation and adaptive presentation. Adaptive presentation is based on the idea of different adaptive presentation techniques that would adapt the content of the pages for the user on the basis of their current knowledge, goals and other characteristics. Adaptive navigation helps users to find their way through hyper-space by adjusting the design of the presentation with links to goals, knowledge, qualities and other characteristics of individual users (Brusilovsky, 1996).

From his publications (Brusilovsky, 2001a, Brusilovsky, 2003a), it is obvious that the field of adaptive hypermedia systems has moved towards learning styles. The author ponders the problem of systems that try to adapt to learning styles without actually being aware which aspects of the learning styles are worth being modelled upon, and what can be done differently for users with different learning styles (Brusilovsky, 2001b). Besides adaptation in navigation and presentation, adaptation in content selection has been added.

Web adaptive systems now already have several generations. First generation was based on the mentioned adaptation of presentation and on supporting adaptive navigation. It focused on users' knowledge and on modelling their aims. Supporting adaptive navigation can speed up the navigation and learning, while adaptive presentation can improve the understanding of the content.

Second generation of adaptive webs expanded adaptive hypermedia with research on adaptive content selection and adaptive recommendations based on the model of users' interests. The third, „mobile“ generation incorporated adaptation of added models of content (place, time, device platform, bandwidth) to the classic user model and examines the use of known technologies in adapting teaching to individual users but also to the context of their work (Brusilovsky, 2003b). Authors of adaptive web systems also examine how to organise storage of users' information, how to fill in the data and how to retain user's current status (Brusilovsky, Millán, 2007).

The following articles (Brusilovsky, 2008, Sosnovsky, 2009, Hsiao, 2011) deal with partial issues. The articles deal with, e.g. the possibility of unifying student's profile for integration into different web-based adaptive systems; creation of the adaptive system guide; and creation of communication interface for students.

The field of adaptive teaching is also touched in the article called *Behaviour Based Adaptive Navigation Support* (Holub, M., Bieliková, M., 2010). The authors introduce a method of supporting adaptive navigation and link recommendation. The method is based on the analysis of user's navigation structure and their behaviour on web pages when browsing through a web portal. Interesting information is chosen from the web portal and recommended by the system. The used criterion is not user's rating of pages and their contents but their preferred choice of pages.

Another article by the same authors, *On the Impact of Adaptive Test Question Selection for Learning Efficiency*, presents a method of adaptive selection of test questions in a web-based education system according to students' needs. The aim is to choose a question from a set of existing ones that is most suitable for the student, together with its content. Authors recommend an adaptive approach to question selection using three methods that are applied step by step as selection filters.

Principles of Creating Adaptive Environment – Module Creation

Current LMSs contain study aids, manage teaching, keep student records, their activities and results, but they do not work with learning styles. The curriculum is provided to all students in a same manner, without taking their learning styles and levels of knowledge into consideration. When students are not in direct contact with their teacher, they learn from textbooks. Textbook authors try to construct topics in a way to be accessible for the majority of readers, leaving some students and their specific learning styles behind. The question is if the progress through electronic study course can be modelled in such a way to be convenient for every student. We are trying to find methodology and algorithms to search for optimal progress that would respect differences among students on the basis of discovering their learning styles and in accordance with their knowledge and skills as they change during the course of study. Identifying learning needs of students and providing suitable and appropriate study materials for them accordingly. The result of our efforts should be an adaptive eLearning environment that is able to automatically adapt to specific requirements of students through created expert system.

The structure of the newly created electronic adaptive environment comprises of three modules – student module, author module and adaptive module.

Module Student

As the name suggests, this module is intended primarily for students. Generally speaking, students have different motivation to learning, different family background, different habits of when and how to learn, different preliminary knowledge of the currently studied subject, different degree of talent for different fields, diverse learning styles, types of memory and memory training, they need different depth of knowledge, understanding, use and application of obtained knowledge, they can be focused or tired, etc.

If we combine the previously mentioned characteristics, we obtain the learning style of the student. Currently there are many sub-categories of learning styles by various authors. By analysing and studying the already published classifications, the following characteristics have been selected as suitable for consideration in eLearning. The characteristics are divided into several groups:

- 1) Sensory perception – describes the form student prefers for receiving (offering) information. Visual type prefers diagrams, pictures, charts and graphs. Auditive type prefers spoken word and contact with other people. Kinaesthetic type likes practical examples, models and practical information. Verbal types prefer using textual form of information (Fleming, 1992 in Kostolányová, 2010).
- 2) Social aspects deal with what kind of company students enjoy while learning, whether with other students, with teacher or alone (Mareš, 1998 in Kostolányová, 2010).
- 3) Affective characteristics deal with the emotions and attitudes of students that impact learning. The most important characteristic of this category is motivation, which can be examined in two components – external and internal. While the source of external motivation can be found in external conditions, e.g. working requirements, parents, etc. internal motivation comes from within the student (Mareš, 1998 in Kostolányová, 2010).
- 4) Learning tactics describe the way (methodology) in which the student learns. Systematicness of learning describes whether the learning is done in successive logical

steps (order) or somewhat randomly, without any obvious connection in great leaps (freedom) (Felder, 1998 in Kostolányová, 2010).

- 5) The way of learning divides tactics into theoretical deduction, which characterises students that prefer in-depth contemplation over the newly gained knowledge, and into experimental tactic used by students who like to actively try the newly learnt (Felder, 2009 in Kostolányová, 2010).
- 6) The progress of learning divides tactics into detailistic, which focuses on minute details of specific information that gradually create the whole image, and into holistic, which focuses on big parts of abstract information, making its way to details afterwards (Sternberg, 1999 in Kostolányová, 2010).
- 7) Student's learning can be divided into three levels: in-depth learning, in which student's main interest is to understand the subject matter; strategic, in which the student wants to effectively achieve the best possible results; and superficial, in which the student aims to simply pass the minimum requirements (Entwistle, 2000 in Kostolányová, 2010).
- 8) Self-regulation of learning shows the degree to which the student is able to independently manage their studies. This then determines the amount of external control during studies; on one end there are students needing precise guidance, on the other end there are students who like to manage their studies on their own (Mareš, 1994 in Kostolányová, 2010).

Module Author

In order for the student to be able to learn on their own, they need to have learning material at their disposal. If the provided curriculum is to be adapted to the corresponding learning style of the student, their personality, depth of knowledge and other characteristics, the teaching material needs to be created in different versions, with different details and various multimedia elements.

Each chapter of each thematic whole presents the curriculum in a structured form – chapters are divided into sub-chapters, paragraphs, etc. The smallest compact unit providing information will be called frame. The frame corresponds with the lowest level of numbered or otherwise marked paragraphs or with one web page including all multimedia elements.

It needs to be noted that the structure and form of each frame is individual. Students with abstract thinking and solid theoretic background will appreciate curriculum distributed in different way than those students who, in order to understand the issues better, need to try everything hands on, understand the meaning and importance of new information and only then will they be willing to accept a given theory. Similarly, students who enjoy written information will appreciate different kind of frames than students with acoustic memory, or students with visual memory, etc. Each frame can be presented with different information depth – from superficial frames with basic information to complex sets of knowledge of the given topic (Kostolányová, 2009).

It has been decided beforehand that each frame will be discriminated by the form of instruction, level of detail and progression of the lecture. Each frame is always divided into an instruction part and a testing part. The instruction part is further divided in accordance with traditional teaching into individual layers – theoretical, semantic, fixation part, practical and motivational. Interactive combinations of these layers will create different progressions of lectures. The testing part consists of various types of questions, tasks to be solved, practical exercises, etc. For clear characterisation of each frame version it is crucial to describe it with adaptive

algorithm – metadata. Creating this type of „adaptive textbook“ is much more demanding than the creation of classic teaching texts or textbooks (will be discussed further).

Adaptive Module

If we prepare adequate study materials (module author) while accepting personality characteristics of the student (module student), we acquire the basis for creating the last module – the adaptive module. This module will be targeted on a specific student, or rather a group of students with shared personality characteristics. Creation of the adaptive module is the most difficult one – the most crucial part is to describe rules that will govern the optimal selection of suitable frame versions. The frames will then be presented to the student, continuously checked with theoretic questions and exercises, and if the student passes the frame, they will be able to continue with the course. In the opposite scenario, if they fail the frame, they will be explained the curriculum in a different, more comprehensive way, with additional exercises for revision, and thus be able to pass the frame.

Creation of the adaptive module requires a team of experts from different areas:

- pedagogical experts creating the professional aspect of the frames;
- psychologists collaborating on the student’s personality aspect;
- information specialists implementing the created materials into the teaching environment of the authorial database and monitoring all activities of specific students that use the adaptive eLearning.

The aim of the above mentioned team is to guide the student to the defined targeted state, i.e. knowledge of specific thematic unit.

The principle of adaptive learning environment can be schematically depicted by the following diagram:

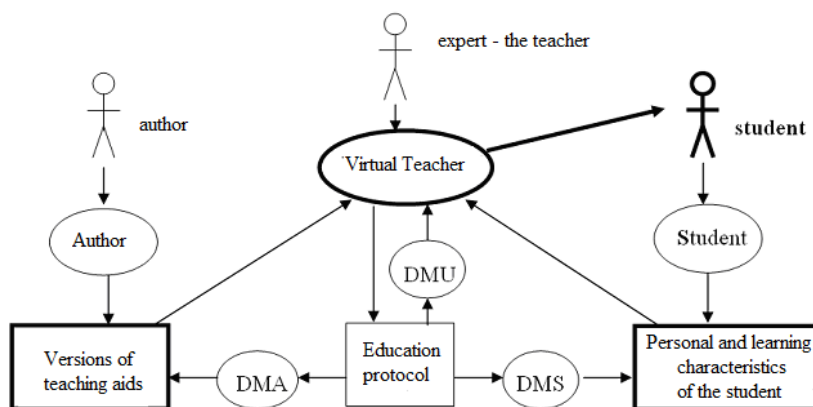


Fig.1: Model of adaptive learning environment
(DMA, DMU, DMS = datamanaging from autor, teacher, student)

The key figure is the student, for whom the whole system is being built. We need to know enough information about the student, so that the system can adequately react to their current knowledge and learning characteristics. Through the Student Module (right part of the diagram) the system can test each student or use suitable questionnaire to find out and save their characteristics in student database.

The second supportive module is the Author (left part of the diagram). It serves for saving or modifying teaching aids in the authorial database. The database contains not only texts, pictures, multimedia, etc. for teaching, but also enough information about them, the so-called metadata. This data contains information about every part of every teaching aid, e.g. whether it's a definition, motivation for students, independent task, etc.

The actual managing programme Virtual Teacher (ellipse in the middle top section) will then load all the required information about the student, all the information about the structure of the given teaching material, and determine – on the basis of this information – optimal education method. To do this, it requires the pedagogical-psychological knowledge mentioned in the previous chapters and with this information it creates detailed plan of the education process. It comprises of a certain expert system that contains basic pedagogical rules, which it then uses to create optimal teaching style for a specific student with an optimal guidance through specific teaching material.

Adaptable Teaching Aids

To know the learning style of a specific student is not enough. In order to individually adapt the educating, the teaching aid needs to be created differently. It must be adaptable, changeable. What does adaptable teaching aid mean then?

The structure of the textual part of eLearning teaching aids is usually identical with the structure of classic textbooks. ELearning aid is usually supplemented with multimedia elements, tests, organisational and communication tools, etc. Because every author has their own style of instruction and knowledge testing, the structure of their textbooks usually corresponds with their teaching style. Authors often create precise theories without describing them more loosely and demonstrating them on practical examples of their applications; others will focus on many practical examples without thorough definition of the theory and its terminology, etc.

In order for the eLearning system to be able to adapt education, it has to have variably created teaching aids at its disposal and be able to present them to each student differently. One of the approaches is for the author to create several textbooks on the same topic, while using different teaching style each time; this method is not very suitable, however. Firstly, author with their own specific teaching style will have hard time using completely different teaching styles; secondly, there are numerous types of students – creating new teaching style for each learning style is completely unrealistic.

The basic difference between the teaching aid forms will be based on the sensory perception of the student. Therefore, each frame will have different sensory versions: one with a prominent text section (for the verbal type of student), one with numerous pictures, graphs, charts and animations (for the visual type), one with spoken word, audio-tracks, communicating and discussions (the auditive type) and another with creative tasks, constructions, etc. (for the kinaesthetic type). Creating these 4 versions according to the sensory form will not be a problem for the author.

Another suitable division of the versions will be by student's conception – in-depth, strategic, superficial, i.e. by the level of „understanding“. Experienced teacher will know that some students will only need regular instruction, while others will need slower, more comprehensive instruction rich with examples. Other types will require yet additional information, connection with other subject, so that they do not get bored. Creating 3 versions with different depth of the instruction should not be a problem for the author. Each version needs to be done for the different already mentioned sensory versions.

The learning style of the student is affected by many other characteristics. The study material, however, cannot be multiplied and differentiated infinitely. Let us ponder how the instruction differs for these other characteristics.

Theoretically well prepared study type of student will prefer the classic instruction in the order of: lecture (theory – explanation – examples) – confirmation (control questions – exercises). *Unmotivated* student will be needing motivation to study, for example in the form of motivational practical examples being solved – followed by the explanation of the solving principles – then by theory – and control exercises. Student without *self-regulation* will be needing detailed directions, guidance, what to do or study first, what next. *Holistic* student will need brief overview of the whole chapter before anything else, and only then will they move to detailed information.

Let it be noted that the instruction for different types of students differs mainly in the sequence of delivery of partial information in each version. We will call these partial portions **layers** and analyse the types of occurring layers. This reasoning is in accordance with the definition of the term *teaching method* (Průcha, 1998).

Teaching method: *Procedure, journey, way of teaching. It characterises the activities of the teacher leading the student to set education goals. There are several classifications of the methods, e.g.:*

- *by the phase of teaching process (forming, consolidating, examining knowledge);*
- *by the way of presenting (verbal, visual, practical);*
- ...

This definition's two classifications formulate the phases of the teaching process, which we further structuralise by layers, and also introduce way of presenting that is in accordance with our combination of sensory forms and layers.

Adaptable Structure of Teaching Aids

Teaching aids need to be structured in a similar fashion, which will allow adapting the teaching style to fit the student's needs by selecting suitable versions of instruction and sequence of individual layers.

Structure of aids and their individual elements will be characterised in detail below:

Subject is the highest unit of a teaching aid; subject is understood as a semestral whole at the university; subject is further divided into lectures.

Lecture is a education unit equal to the classic class/lesson. It does not have to reflect chapter from a textbook, scope of chapters can vary. Lecture divides into frames.

Frame is the elementary part of lecture comprising of single unit education information; this level is analysed for its versions and layers. The so-called basic frame defines the teaching aid's content; the versions of frames differ only in form or depth of instruction, not in content.

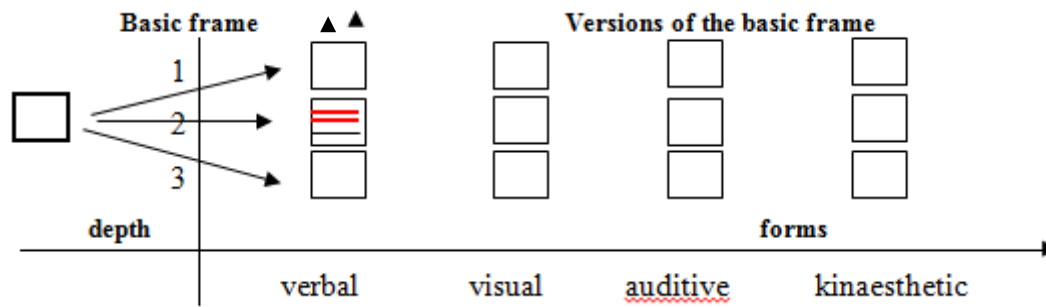


Fig. 2: Variations of framework

Frames versions are different ways of instruction and examination of the same subject matter (Kostolányová, 2010).

Based on the reasoning in the previous paragraph, we propose up to 4 versions by the preferred sensory perception of the student (called also 4 sensory forms of the versions) and up to 3 versions of different depth of instruction. This gives us the total of $4 \times 3 = 12$ versions in two „dimensions“.

It is not necessary to always utilise all 12 versions. It is left at the discretion of the author of the aid to create those versions that they feel are relevant and leave those that are not needed.

- **Frame versions by the sensory form**

From the form point of view, we divide version into the four already mentioned types (columns in the chart above):

Verbal – this version is mostly textual,

Visual – this version contains many pictures, graphs, animations, etc.

Auditive – this version contains a lot of spoken word, sounds, videoconferences, etc.

Kinaesthetic – high number of interactive educational programmes, etc.

It is rare for any version to be done purely in one form. It is usually a combination of forms and then the author decides on the percentage ratio between each form. The dominant form will drive the categorisation of the version and its place in the „version matrix“ above.

- **Frame versions by the depth of instruction**

Depth of instruction represents the complexity of instruction, specifies the detailedness of provided educational information. So far, we recognise 3 levels of depth.

Basic level is the depth no. 2. This is the most common type of instruction in terms of detailedness. Its content and scope is decided by the author. Each version can also contain questions or exercises. They can be used by the system to verify that the student understands the subject matter. If the answers are correct, the system provides additional information (additional part of the frame, or next frame) with the same level of depth.

If the student answers incorrectly, the system can offer more detailed instruction in the 3rd depth level with simpler exercises that are gradually getting more difficult. There are also more questions in smaller units.

For excelling students who understand quickly, the system can offer additional information, interconnections and relation to other field, etc. within the 1st depth.

- **Layers of the frame versions**

Variants with different form and depth of instruction would not be enough to cover the necessary differences of the teaching styles. The instruction has to reflect other different personal traits of students. By analysing these students' characteristics we found out that the instruction also differs in the sequence in which partial information and continuous examination is delivered, as well as organisational information.

Adapting the teaching style of the frame will be enabled by dividing the frame into partial segments – layers (Kostolányová, 2011). The **layer** of the frame represents a homogenous part of the frame in terms of the teaching process (theory introduction; explanation; forming, consolidating & examining knowledge; motivation; managing education).

Types of layers:

- **Explanatory** – group of layers that contain the actual instruction of the given subject matter. It comprises of:
 - T Theoretical** – containing the theory: definition, terms, rules, algorithms, etc. The most important layer from the teaching point of view.
 - S Semantic** – explaining existing terminology, formally describing theory, additional information to the theoretical layer, explains the consequent interconnections of a theory, etc.
 - F Fixating** – to help remember the theory better by using repetition, different wording and alternative terms, explaining the broader context.
 - R Resolved exercises** – contains examples that use the theory, solved „school“ examples. They serve as example for solving other exercises delivered to the student.
 - P Practical** – contains solutions to practical, real-life, exercises that use the taught theory.
- **Testing** – group of layers for continuous testing of obtained knowledge; tasks that serve for fixating the knowledge and obtaining practical skills. They comprise of:
 - Q Questions** – questions concerning the given curriculum. They can serve the student only, or they can be used by the adaptive algorithm to manage further instruction.
 - E Exercises** – „School“ exercises for solving.
 - X Practical tasks** – real-life tasks.
- **Other layers**
 - M Motivational** – motivational information about the subject, lecture or frame that explain the contribution of this study to the unmotivated student
 - N Navigational** – didactic information, organisational; a certain kind of guidance through the lecture or subject matter and recommended progress through the studies, etc.

Information on the form and depth of the instruction and type of layer must be stored in the metadata. Metadata enables the system to correctly choose and manage the education.

In order for the authors to be able to focus fully on the structuring of the aid and its actual content and not waste time with how to create several versions of it with several layers, the following MS Word form has been created. Authors simply fill it in with their teaching texts. Each version of each frame (sensory and depth) is recorded in an independent form. The left column serves for the actual text of the aid, teaching and testing (i.e. components of the aid); the right column is filled with metadata, i.e. supplementary information about the version type and its parts. The author deals with the actual content of the textbook and they are minimally bothered by recording its classification and metadata (Kostolányová, 2011).

Structuring of the teaching aid helps the author and students to structure their knowledge, discriminate important new terms, understand their interpretation, place them in context of previous knowledge, understand the importance of new knowledge in real-life application, separate pedagogical comments, etc.

Subject: [title of the subject](#)

Uni: [title of the unit](#)

Framework: title of the framework	
Variant – depth	MFDep= 1-3
Variant – form	MFor = vis, ..., kin
Content of the T layer	MVrs = T
...	MVrs = S
	MVrs = F
	MVrs = R
	MVrs = P
	MVrs = M
	MVrs = N
	MVrs = M
	MVrs = L
Title of the question 1_1	MVrs = Q
Text of the question 1_1 xxxxxxxxxxxxxxxxxxxxxx	
var 1	
var 2	
...	
Type of evaluation (absolute, percent)	
Points for a matching answer	
Text of non-typical verbal response to the answer	

Tab. 1: Form for adaptive textbook

Conclusion

The described principles of intelligent teaching clearly demonstrate that the project is wide-ranging and requires cooperation between several types of experts. This brief overview of the whole system of individualised teaching does not mention many partial related problems, both theoretical and practical.

Currently, the Student and the Author subsystems and the majority of the Virtual Teacher subsystem are, concerning the theoretical point of view, solved. The Virtual Teacher subsystem is currently dealing with ambiguous and conflicting situations during the student's teaching style creation and with the theoretical model of protocols and their analyses. Theoretically established subsystems have already been created. The original learning management system (LMS) Barborka – that has been extensively developed and used at the partnership university of the project: VSB-TU Ostrava – has been used for the implementation of the whole system. The Barborka 3 version already has the Student and Author subsystems implemented together with the new Virtual Teacher subsystem that enables adaptable teaching.

Its adaptable version will be launched and pilot tested in real-life teaching.

Individual versions of the teaching material, as has been described above, are needed for the testing. The creation of the teaching materials is being done in parallel with the research on the system. Several subjects from different professional fields have been chosen for teaching aids creation: informatics, foreign language, natural science subject, social science subject, technical subject. In that way, the suitability of the proposed theoretical principles of the structure of the teaching aids will be tested for different types of subjects, therefore showing their usability for adaptive teaching.

In the following development of adaptive process, several other related tasks will have to be solved:

- further analyse and specify the set of characteristics that define learning style of the students;
- formulate additional pedagogical rules that assign a teaching style to its learning counterpart, solve their combinations, or possible conflicts of the rules;
- in connection with the previous point: enlarge current metadata of education elements (frames, versions, layers) with metadata that would enable combinations of elements of different frames, or even lectures or subjects;
- create feedback by analysing the student protocol with statistics and data mining methods and integrate it with the set of virtual students as well as personal traits of the actual students;
- create feedback by analysing the student protocol with statistics and data mining methods and integrate it with the teaching aids of specific subjects and recommend their improvements;
- create feedback by analysing the student protocol with statistics and data mining methods and integrate it with the expert rules of the Virtual Teacher and recommend their modification.

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