Impementation of the Adaptive System in Elektronic Learning

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The paper presents one solution in the development of the adaptive system of electronic learning in the personalized environment LMS Moodle. The practice so far has shown that numerous electronic distant learning courses failed, due to the same static learning contents being implemented for all the students, which resulted in lack of motivation and poor results. The primary objective of this research is the personalization of electronic learning systems geared to the identified abilities, needs and preferences of each student, including the defined learning styles, too. The students were classed into three characteristic groups and the model of adaptive distance education system was presented.

1. The learning management systems

The Learning Management Systems (LMS) are independent systems implemented in web technology-based education. The software that is the basis of the LMS controls all the elements of learning and records all the parametres required for the monitoring of the education process [14]. These parametres allow for the monitoring of the development of each individual student or group at any given moment, as well as for a reliable measurement and analysis of the results at the end of the education process.

The literature quotes several similar concepts which are frequently used as synonyms to the LMS: course management systems (CMS), virtual learning environments (VLE) and learning content management systems(LCMS). Strictly speaking, the differences among them are clear, e.g., the LCMS are the systems that, among other things, allow for creating the learning objects (LO) and their designation by the metadata, while the LMS do not offer such opportunity, but rather work with the previously prepared courses [11].

Some of the presently available LMS on the market are: Moodle, WebCT, Bazzar, College, eLearner, First Class, Intra Learn, Lotus Learning Space, Lotus Same Time, Tutor, dot LRN, Fledge, Ilias [9]. Unitl 2006, Blackboard and WebCT were separate commercial products, since then they have operated jointly [14]. The Moodle is developed and is is still developing as an open code project.

1.1. LMS moodele

The Moodle is a modular-object oriented environment in learning development that is easy to compose and that offers an integrated user interface. The basic features of this system can be summed up as follows:

- High availability – capablity of serving thousands of users simultaneously.
- Scalability – capability to support an increasing number of users without failing in performance
- User-friendly – an opportunity for the user (student or teacher) to master the use of the system in a short time
- Interoperability – capability of integrating with the existing software
- Stability – a stable version of the Moodle software ensures uninterrupted services to the student and teacher populations
- Safety – it is a quality of the system that it is not a higher safety risk in comparison to other components of the information system.

The above-mentioned features were sufficient for the authors to decide upon using this learning management system in this work.

Moodle needs no modifications in order to be implemented in Unix, Linux, Windows, MAC OS X, Netware, or any other systems supporting the PHP, including the majority of the Internet providers. The data are stored in only one database: MySQL and PostgreSQL, however, Oracle, Access, Interbase, ODBC and others can also be used [17].

Moodle is not the adaptive education MLS [3], however, in this work it is adapted only to the methodology area, without software changes.

2. Mmethodology

The first step in this research was to conduct a poll among the students in order to learn about their previous education, their preferences in learning, as well as the experiences in their work with the Moodle learning system. In addition, our goal was to identify each student's learning style.

The Felder-Silverman model defines the following learning styles [5]:

- active and reflexive learning style
- sensor and intuitive learning style
- visual and verbal learning style
- sequential and global learning style

The module graph (Figure 1) typical of group 1 shows the following:

- The lessons within the module are grouped acording to their respective priority.
- The student-beginner follows the linear path in mastering the lessons.

Activity	Active	Reflexive	Visual	Verbal	Sequential	Global	Sensual	Intuitive
Forum	Concrete topics and problems	Issues to consider	No	Yes	Topics on each area and course part	Global topics	Facts, examples	Abstract topics
Chat	Yes	No	No	Yes	often	sometimes	Yes	No
Dictionary	As many terms as possible	Concepts	No	Yes	Yes	No	Yes	No
Workshop	Experiment, concrete problems	Discussing unexplored topics	Yes	Yes	Yes	Yes	Yes, with practical examples	Innovative topics
Research	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Selection	Yes	Yes	Yes	Yes	Yes	Rarely	Yes	No
Lesson	Yes, with problems and examples	Yes, with issues to consider	Yes, illustrations	Written and audio materials	Yes	Rarely	Yes, facts, algorithms	Rarely
Contact with teachers	Face-to-face	E-mail	Combinate	Combinate	Combinate	Combinate	Face-to face	Combinate
Case study	Yes	Yes	Yes, illustrations	Written and audio materials	Yes	No	Yes	Yes, innovative topics

Table 1. Relations between the activities in the Moodle system and the learning styles [5]

The values of the atributes within one group are similar, whereas they differ significantly from group to group. The students were divided into three groups, so as to obtain more consistent, more logical and better quality results.

3. Content adaptation and ontent cluster-based navigation

Adaptability is implemented on the contents level (content-adaptation) as well as on the link level (link-adaptation) [1].
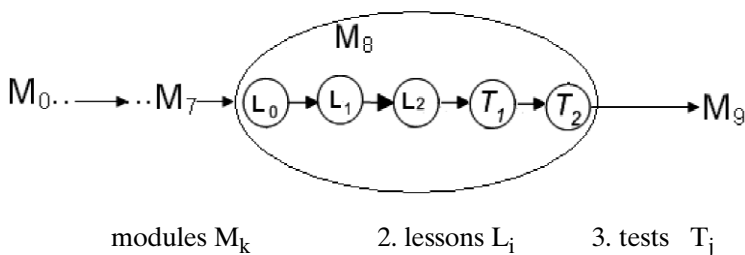
Group 1 (beginner level students)

- The module includes a preliminary test as well as a final achievement test.
- Navigation is conditioned by the final test results.
- Group 1 is offered only a short introduction into the topic to be studied, which suits the students without any previous knowledge (Figure 2). Each course week can contain the content description.
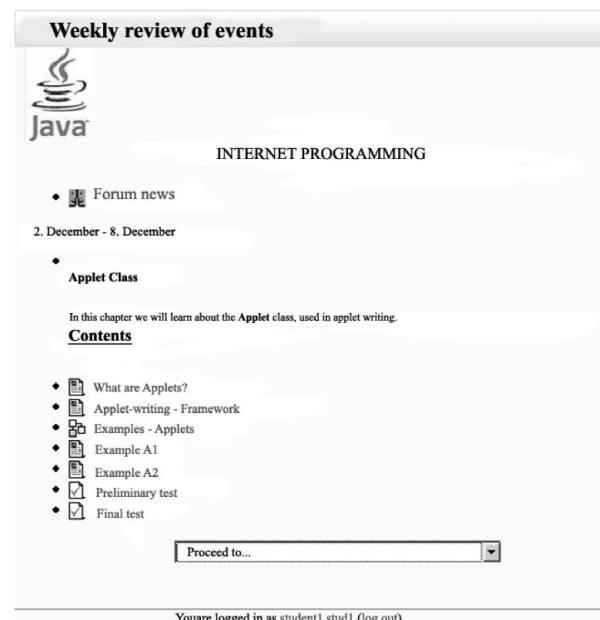

Figure 2. The look of one part of the course

modules M_k 2. lessons L_i 3. tests T_j

Figure 1. *Group 1 module graph*

- In the contents part the student is introduced to the lessons titles grouped within one module.
- Actual examples are given after each lesson, as in this way they facilitate the understanding of the learning contents and enhance learning.
- Lessons are linked by a precondition relation defining which lessons or clusters must be covered prior to moving on to the next lesson.
- It is important for the student-beginner that the number of examples be as large as possible.
- Each example has comments put in curly parentheses with short explanations of each line of the programme code, which the student-beginner will find very important for understanding the programme.
- There are no limits for the student as regards the defined deadlines.
- The Group 1 students take the exam part by part.

Group 2

Figure 3. Group 2 module graph

modules M_k 2. lessons L_i 3. tests T_j

- The module graph (Figure 3) typical of Group 2 shows the following:
- Lessons are grouped within the module according to their respective priority.
- The intermediate level student can take a rendom access to the lessons within a module, whereas random mobility across the modules is not allowed.
- The module includes a preliminary test as well as a final achievement test.
- Proceeding to the next module is possible only upon passing the final test from the previous module.

Figure 4. Additional information for Framework

- Group 2 includes a broader version of the course unit " Applet Writing –Framework" with additional information on the applet-writing tools. The student is offered a selection of sites where he/she can learn more about the applet-writing tools (Figure 4).
- The intermediate level students are recommended some useful links on the Internet. The click on the chosen link automatically opens the web location whose contents are recommended by the teacher/tutor.
- The student prefers practical work to theory.

Group 3

The Group 3 module graph (Figure 5) shows that there is no limitations as to the third group students' (students with a higher level of previous knowledge) mobility across the modules.
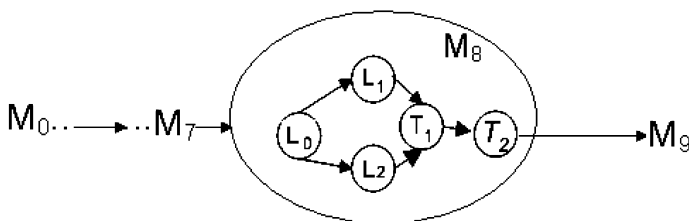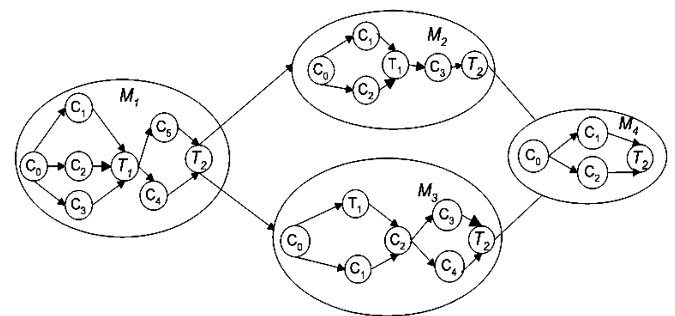

Figure 5. The Group 3 module graph

4. Results and discussion

The basic characteristics of students for each group according to the defined styles are presented in Table 2.

Groups	Characteristics	Identified learning styles
Group 1	Multimedia materials	Visual
	Partial completion of exam obligation	Sequential
	Teamwork	Active
Group 2	Students choose topics	Intuitive
	Practical work	Active
	No strictly defined terms	Global
Group 3	Written materials	Verbal
	Partial completion of exam obligation	Sequential
	Teamwork	Active

Table 2. Study groups and styles

- Adaptability is implemented on the contents level as well as on the level of links by way of certain adaptation methods and techniques.
- At the end of the course, 82 per cent of the students claimed that they found the Moodle easy to use and understand.
- 92 per cent of students maintained that learning in an adaptive environment and at a self-adjusted pace improves their achievement at both the preliminary and the final tests.
- The mood and motivation for learning are significantly improved in all three group students, whereas in the control group students such improvement was not observed.
- The model is easy to implement on the existing open-source systems for on-line learning.
- A detailed review of the adaptive methods and techniques of electronic education is systematized and presented.
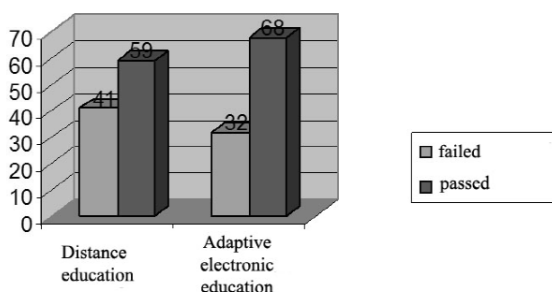- Each group followed a respective course, specially geared to their needs.

Figure 6. Achievement at tests in the adaptive environment of electronic learning

Conclusion

The paper defines a model of electronic distance-learning adaptive system. Basic phases and requirements are identified in the development of personalized systems of e-education, with respect to the identified learning styles. The electronic education group courses are personalized in accordance with the results obtained.

The proposed model supports the adaptability and at the same time maintains the simplicity in the course conducting process. The implementation of adaptability concept in electronic education can improve the efficiency of the education process through the personalized learning system, as well as the efficiency of the e-education system as a whole.

Further research will be oriented towards the completion of the present courses. Of great importance for further study will be the information on the efficiency and effectiveness of the adaptation activities implemented on the existing courses. The research will be extended by gathering new data on the students' characteristics.

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