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One Approach for Modeling of Adaptive Scenarios in E-learning Environments*

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Introduction

The e-learning technologies are in the process of continued development. Now day the strong expectations that high level technological tools will increase the quality of any e-learning course often follow to an underestimation of the educational objectives being set. According to our experience the crucial question is not “What technological tools are to be used during the development process of e-learning courses?” The core problem is “How to design and plan an e-learning course that ensures the achievement of the educational objectives?”

In this way the modern e-learning environment has to pass several requirements:

- to offer the most recent technologies
- to ensure interoperability and reusability of learning materials
- to offer adequate tools to measure the achievement of educational objectives by the learner.
- to offer different leaning paths through the learning materials, depending of student’s learning style and progress in achievement of the learning objectives,
- to possess high level of usability

The last two requirements in fact are basic characteristics of the adaptive hypermedia educational systems described in [1]

The focus of this paper is a conceptual model for development of adaptive learning scenarios in e-learning environment. Section one deals with relevant studies in area of adaptive systems and with the overview of the possibilities for design of adaptive learning scenarios in some popular open source Learning Content Management Systems (LCMS). The pedagogical theories relevant to the development of e-learning adaptive scenarios are presented in section 2. Section three stresses on the modeling of the adaptive learning scenarios, with strong respect of the achieved learning objectives by the student.

Adaptive learning scenarios and LCMS

The idea of adaptive learning itself is not new. Basic ideas and projects can be found to the early 1900s. The grounds of the so called programmed learning are sated by Scinner [4] and Crowder in the 1950s.[2] During the years this ideas have been enlarged concurrently with development of the computers and information technologies.

To day in the century of the Internet the ideas of adaptive learning scenarios accept the new dimensions. In the educational terminology has been became the new term adaptive e-

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learning. In [3] the adaptive e-learning is described like a teaching system which adapts the selection and the presentation of the contents to the individual learner and their learning status, their needs, their learning style, their previous knowledge and preferences.

According to [5] in the modern commercial Learning Content Management Systems (LCMS) such as BlackBoard, TopClass or webCT that can support discussion forums, course material delivery, generation of different course reports the course model is based on a static sequence (or a tree) of modules followed by static quizzes and assignments. In example TopClass follows the classic computer-assisted instruction approach (CAI). This approach offers limited ways to change the student's learning path on the basis of his or her achievement on a quiz.

What can offer the Open GPL LCMS, which become more and more popular such as aTutor, Moodle and Ilias in development of adaptive scenarios?

- **aTutor-** At the moment, learning paths are not available and it's not possible to implement learning activities. [7]
- **Moodle-** Possibilities for generating of programmed lesson. It consists of a number of pages. Each page normally ends with a question and a number of possible answers. Depending on the student's choice of answer they either progress to the next page or are taken back to a previous page. [6]
- **Ilias-** With version 3.2.0 Learning Paths features are available: it's possible to constrain the access to a particular course upon the execution of a previous course, exercise or test. The operation is manual in the first two cases: the tutor should do the evaluation and then enable the students to access the course, in the latter the student, if he pass the test, is automatically admitted to go on in the learning process. With the version 3.4.0 could be assigned learning objectives but the generated scenarios are linear.[8]

Pedagogical theories and development of adaptive e-learning scenarios

From the pedagogical point of view the process of development and implementing of learning scenarios for one lesson covers the follows:

- describing of time of instruction;
- describing of prerequisites knowledge;
- setting of learning objectives, based on the knowledge domain and cognitive level or the knowledge;
- planning of proper didactical methods for achievement of learning objectives;
- planning educational activities, according to the chosen didactical methods
- planning and developing of didactical tools- reading and writing learning materials, tables, schemes, images, video, audio etc;
- planning and developing of assessment methods and tools for obtaining of feedback for student progress regarding to the achievement of the learning objectives.

In case of classical “face to face” learning the adaptive scenarios are realized by the teacher.

In case of e-learning this classical approach for development of learning scenarios has to be improved with respect of technological and pedagogical issues.

The process of development of adaptive learning scenarios in LCMS could be depended from learning style of the students, educational form, type of learning, learning objectives and adequate technological tools

In the pedagogical theory there exist a lot of classifications of learning styles- Kolb's experimental learning theory, Honey and Mumford's theory.[10] The learning style is sustainable way of accepting and processing of new information. Each student has an own style of learning. Knowing the learning style of each student we can to use in maximum the efficient of this style.

The form of education in which the e-learning scenarios will be applied could be specified in two basic classes- distance education or blended education.

The type of learning- self depended learning or group collaborative learning requires the use of different didactical methods and technological tools.

Learning objectives drive the whole educational process. They explore what content should be included in the learning materials and at what level of the cognition of the learning material should be master. The learning objectives evaluate and measure the student achievements. They have to be measurable and their descriptions have to be grounded on the issues- knowledge domain and cognitive domain. The knowledge domain describes the concepts, facts, procedure, and appearance from concrete learned material. Usually the cognitive domain is described according some of well known taxonomies- Bloom, Merrill, Belpako etc.

- **Cognitive levels in Bloom's Taxonomy and description of the objectives:**
 - Knowledge
 - Comprehension
 - Application
 - Analysis
 - Synthesis
 - Evaluation
- **Merril's performance dimension**
 - Remembering
 - Using
 - Finding
 - Generalities
- **Belpako's levels of mastering of knowledge [9]**
 - Understanding
 - Recognition
 - Reproducing
 - Application
 - Creation

The mentioned above factors- learning style, educational form, reflect to the choice of didactical methods. The basic methods that appear to be useful for e-learning could be summarized as follows:

- Lecture;
- Discussion;
- Interactive simulation;
- Problem solving;
- Project based method;
- Exercise;
- Methods of assessment and evaluation.

All of the above methods could be technologically enhanced. Some examples of the technological tools to support and implement these methods are presented in Figure 1.

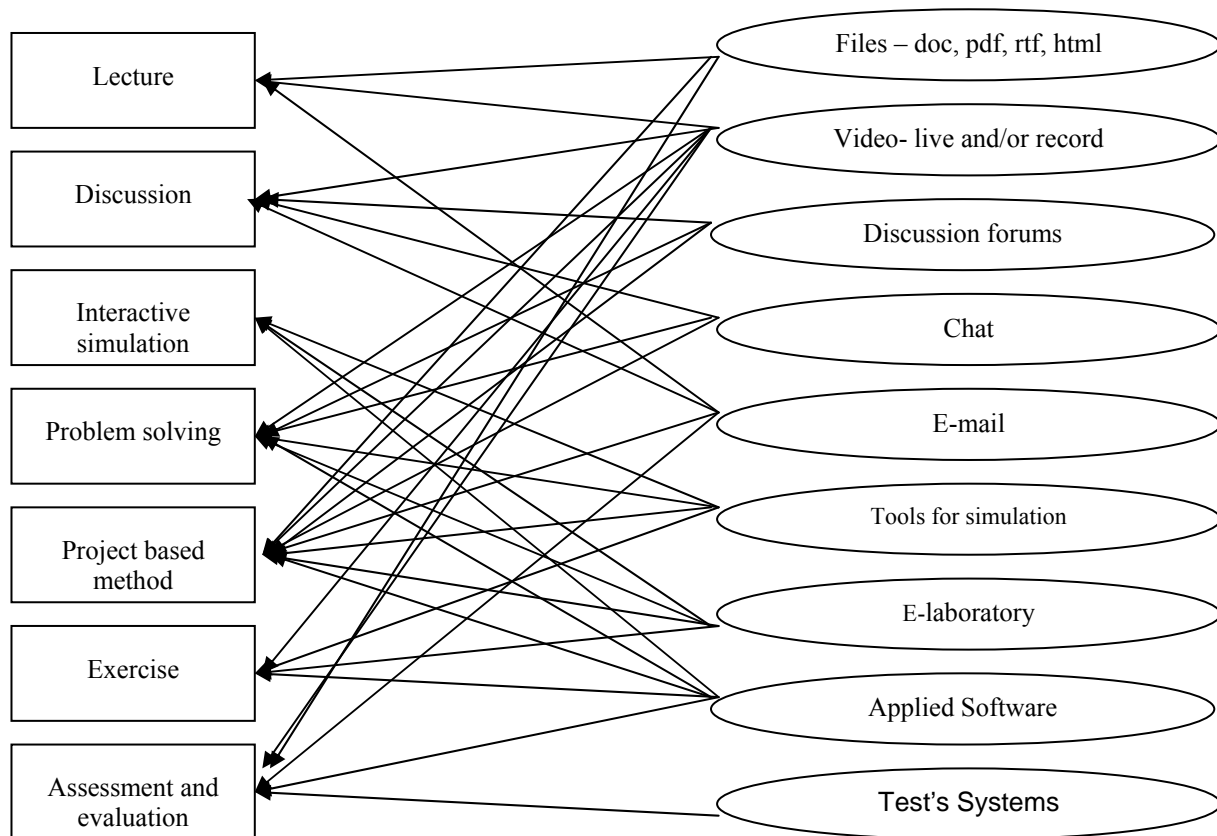


Figure 1. Relationships among didactical methods and appropriated technological tools

In the case of self depended learning the most suitable methods are lecture delivering, interactive simulation, problem based method, exercises. For collaborative learning the group working methods, e.g. projects based method, discussion are suitable.

Consider the constructivist's learners. If this is the case, the methods as exercises, project development, simulation, problem solving are more suitable than lecture delivering. For young learners a game based approach and interactive simulation are fitting.

Conceptual Model for Generating of Learning Scenarios

In our approach the adaptation is based on the learning and assessment components in LCMS with strong respect of learning objectives and criterion- referenced assessment.

The conceptual scheme of the process for development of adaptive e-learning scenarios is presented on the figure 2.

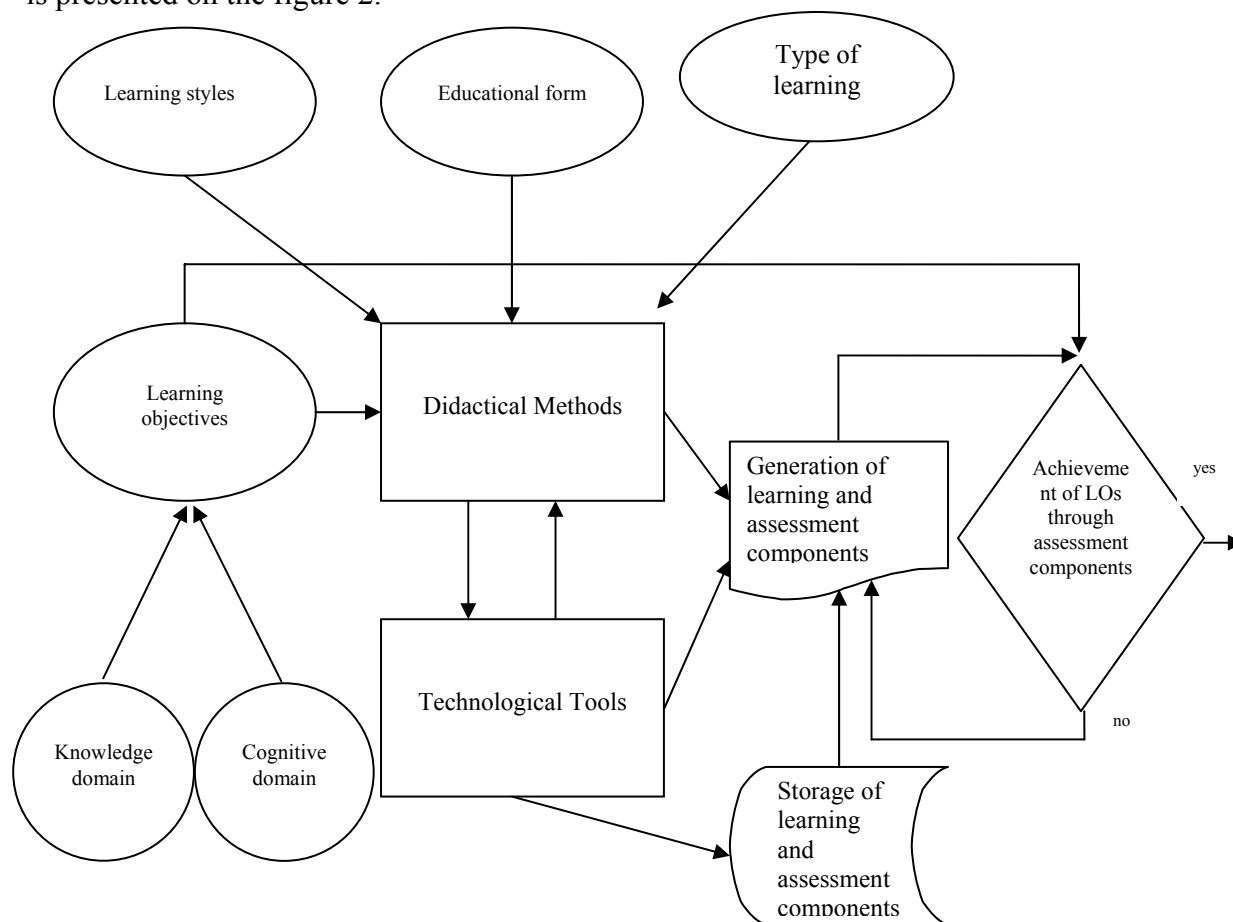


Figure 2. Conceptual scheme of the process for development of adaptive e-learning scenarios.

Learning component (LC) is a learning recourse that is used for achievement of at least one learning objective. The learning component could be presented through different digital media. Learning components could be monolithic or composite. The composite LC is arranged from another LCs, which cover the learning objectives of the composite LC. The monolithic LC is an atomic resource and can not to be separated in parts, although it can cover more than one learning objective. Each LC is described by learning objective matrix. In this matrix 1 means that the LC covers the concept, fact etc. at the appropriated cognitive level.

Learning Component	Cognitive Level 1	Cognitive Level 2	Cognitive Level 3	Cognitive Level 4	Cognitive Level 5	Cognitive Level 6
Concept 1	1	1				
Concept 2	1	1	1			
Fact 1						
.....						

Example learning objective matrix

The leaning modules could be composed and arranged according to the set off learning objectives from the several LC organized in the data storage.

The assessment component (AC) is an assessment resource (test item, test, assignment, practical task etc.) that is used for controlling of achievement of at least one leaning objective. The AC could be presented through different digital media and could be monolithic or composite. The composite AC is arranged from another ACs, which cover the learning objectives of the composite AC. The monolithic AC is an atomic resource and can not to be separated in parts, although it can cover more than one learning objective. Each AC is described by matrix of learning achievements. In each cell of the matrix the “cut off” level in percentages is set.

Assessment Component	Cognitive Level 1	Cognitive Level 2	Cognitive Level 3	Cognitive Level 4	Cognitive Level 5	Cognitive Level 6
Concept 1	89%	80%				
Concept 2	78%	75%	70%			
Fact 1						
.....						

Example matrix of learning achievements

If the student has not reach the “cut off” level for certain learning objectives he’s/she’s learning path will be redirected to the LCs responsible for this learning objective.

Conclusions

A modern e-learning environment not only has to offer the most recent technologies but it has to possess high level of usability also. This environment is to be adaptive to different learning models, e.g. constructivist learning, collaborative learning, experimental learning, problem based learning. The adaptability of an e-learning system could be increased if a possibility to create learning scenarios exists.

In our opinion it is obligatory to take into account the educational objectives during the learning process. There is no sense to carry out some didactical activities without submit them to concrete educational objectives. In the didactical structure of more e-learning courses the educational objectives are described, but usually they are only described without a feed back with learning content and measurement of level of achievement of the set learning objectives.

The focus of the present paper is an approach for modeling of adaptive scenarios strongly based on the pedagogical and psychological theories of learning. The main starting points in planning and developing of any learning processes and teaching activities are learning objectives. Therefore in the proposed model the learning objectives take central place.

Our future works will be directed to the extension of the model regarding to the compatibility with the e-learning standards.

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