Framework for personalized e-learning model

MAIJA SEDLENIECE, SARMA CAKULA
Faculty of Engineering
Vidzeme University of Applied Sciences
Cesu street 4, Valmiera, LV - 4200
LATVIA
maija.sedleniece@va.lv, sarma.cakula@va.lv, www.va.lv

Abstract:
As an alternative for full-time studies different forms of education which are possible to combine with work and family life are strategically being developed worldwide. E-learning is one of these development directions. Distance learning using modern technologies, becomes more and more popular but not always these approaches are successful because there is not a clearly defined methodology for each individual learners needs and technological capabilities.
The aim of this paper is to give a theoretical background for e-learning personalization and develop a framework for personalized e-learning model.
This research offers a theoretically grounded framework for personalized e-learning model which is based on four properties of personalization: student learning style, ontology based concept tree, learning units and course content adaptation to devices used.

Key-Words: - E-learning, personalization, learning styles, e-learning course development

1 Introduction
Most of the students after graduating from secondary school are forced to look for a job to support family and themselves. The same time studies, which are compatible with work, are becoming more popular and consequently also increasing interest in e-learning.
E-learning is an abbreviation of electronic learning. Australian National Training Authority defines e-learning as covering applications and processes, which use all available electronic media such as Internet, audio/videotape, interactive TV and CD-ROM to distribute instruction more flexible. The ILRT of Bristol University describes e-learning as the use of electronic means to deliver, help, and enhance teaching, learning, and assessment.
Summarizing all reviewed definitions authors defining e-learning as using Internet to access learning materials, to interact with the content, teaching staff and other students, to get support and knowledge in study process and on the base of acquired knowledge make their own opinion. [2]
Unfortunately, current e-learning platforms do generally not include or even consider some important characteristics capable of providing user adaptivity in a satisfactory manner. For instance, they do not pay attention on the students learning styles; thus, all students are shown the same materials and activities.
Nor do didactic materials offer any re-usability possibility due to the lack of granularity or access possibilities to different devices (PC, PDA, cell phone, and so on) in an efficient way [3], [4].
Education research confirms beyond any resemblance of doubt that not all learners are able to learn successfully at the same pace, with the same approach, in the same environment, on the same path and in the same style and manner. Research confirms that every individual assimilates information according to their own unique learning style, need and interest. [5]
For now the education system still is a giant sorting system that selects out individuals who tend to:
• learn in certain ways
• teach in the ways that they have been taught
• select out individuals who learn in the same way that their professors did.
A lot of student don't match these sorting criteria and very fast lose motivation complete ongoing course and also learn. Students' lack of motivation is the one of the reasons, which makes e-learning course creators focus on new methodologies for e-
learning process improvement and personalization. Personalized learning is widely considered as one promising direction towards the full exploitation of the potential of the information society in education. The aim of this research is to give a theoretical background for e-learning personalization and also develop framework for personalized e-learning model.

The structure of the paper is as follows. In Section 2 will be presented personalization concept in e-learning. Next three sections will be concentrated to different directions of personalization – learning styles, semantic web and technological approaches. In Section 6 will be given framework for personalized e-learning model, but in Section 7 concluding remarks and future work will be given.

2 Personalization concept in e-learning

Personalized learning and teaching could be regarded as an ultimate level of instruction. Confucius, a great thinker, philosopher and educationist of China, presented a philosophical statement about 3 000 years ago. [6] His philosophy in teaching is known as: “teach students in accordance with their aptitude, adjust measures to local conditions” [7].

Personalization in the context of computer science refers to the ability of a system or application to adapt the needs of each user. Personalized Learning is dedicated to developing individualized learning programs for each learner whose intent is to engage each learner in the learning process in the most productive and meaningful way to optimize each learner's learning potential and success. [5]

In the context of e-Learning, personalization could be applied to some aspects, which are personalization of learning material (based of preferences, learning style, educational background, capabilities), ways and presentation form of learning materials, or the composite of them [8]. There are several methods that can be implement to do personalization in e-learning[9]:

- Personalization controlled by the learner - It requires direct input of the learner's needs and preferences by filling question forms or by choosing options and alternatives.
- Personalization based upon an existing user profile and meta-descriptions of the information content - In this case, the learners' preferences are stored in their profile.
- Personalization via searching for a correlation between the learners - Correlation is through the values of the attributes, describing the learner's profile. If there is a strong correlation, there is a possibility that the content for a given profile is suitable for applying to its close(adjacent) profiles.

The personalized learning concept signifies a radical departure in educational theory and technology, from “traditional” interactive learning environments to personalized learning environments. Some of the most prominent characteristics of personalized learning environments can be summarized as follows:

- they are based on the one-to-one or many-to-one learning concept (i.e. one, or many tutors for one learner);
- facilitate learning independent of time, location, etc;
- the learning material and sequencing, learning style, learning media, etc, depend on the individual learner's characteristics, i.e. background, interests, skills, preferences, etc;
- the curriculum, learning units, etc, are based on the learner's requirements (self-directed learning). [10]

Exploring the concept of personalization in e-learning authors define three main directions of development:

- Students personality-learning styles.
- Structure of information-semantic web.
- Technological device used-technological approach.

There are different theories, which describe students personality and the way students learn, receive and process information, therefore in the next section some of the most important views will be described.

3 Learning styles

Keevel formally defines learning styles as “characteristic cognitive, affective, and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment.” [11] More simply learning style can be defined as the way person collects, processes and organizes information. These differences among perceptions describe learning models.

Many different kinds of learning style models have been developed based on different aspects of personality. Some of these models will be discussed in this section.

3.1 Visual-Auditory-Kinesthetic (VAK)
model
One of the model concentrates on human observation channels; vision, hearing and feeling. The observation channel model or in other words the Visual-Auditory-Kinesthetic (VAK) model bases on the basic observation channels of human. The learning styles are divided into four categories; visual (verbal), visual (non-verbal), auditory and kinesthetic.
Sometimes the word tactile is connected to the kinesthetic category changing the model name into Visual-Auditory-Kinesthetic-Tactile (VAKT). The VAK model is not a learning style in a way that the other learning style models are. It is not developed by any specific person or persons. [12]

3.2 Felder-Silverman model
The Felder-Silverman learning style model (FSLSM) was created by Richard Felder and Linda Silverman in 1988. It focuses on aspects of learning styles on engineering students.
The model had five dimensions in the original version but was changed to four when one dimension was deleted. The learning style dimensions according to Felder are:
- sensory/intuitive
- visual/verbal
- active/reflective
- sequential/global. [13]

3.3 Kolb's learning style model
David Kolb developed his learning style model over years basing it on the research on many others, for example Rogers, Jung, and Piaget.
Kolb's learning theory includes four different learning styles, which are based on a four-stage learning cycle. The learning cycle stages are:
- Concrete Experience (CE) - feeling
- Reflective Observation (RO) - watching
- Abstract Conceptualization (AC) - thinking
- Active Experimentation (AE) – doing

Figure 1 shows a flow chart on Kolb’s learning cycles and styles. Kolb says that concrete experiences lead to observations and reflections. These reflections are absorbed and translated into abstract concepts with implications for action, which a person can actively test and experiment. This enables creation of new experiences and starts a new cycle.
The learning styles definitions are representations of the combination of two preferred styles (see the abbreviations after the cycle stages):
- Diverging (CE/RO)
- Assimilating (AC/RO)
- Converging (AC/AE)
- Accommodating (CE/AE) [14]

3.4 The Myers-Briggs learning style model
The Myers-Briggs inventory is based on Carl Jung’s theory of types, outlined in his 1921 work Psychological Types [15], [16], [17]. Jung's theory holds that human beings are either introverts or extraverts, and their behavior follows from these inborn psychological types. He also believed that people take in and process information different ways, based on their personality traits. The Myers-Briggs evaluates personality type and preference based on the four Jungian psychological types. The Myers-Briggs Type Indicator reports a person's preferences on four scales which, is given in Table 1.

### Table 1 The MBTI preferences and their definitions.

<table>
<thead>
<tr>
<th>Preferences</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraversion or Introversion</td>
<td>Where a person prefer to focus their attention</td>
</tr>
<tr>
<td>Sensing or Intuition</td>
<td>The way a person prefer to take in information</td>
</tr>
<tr>
<td>Thinking or Feeling</td>
<td>The way a person prefer to make decisions</td>
</tr>
<tr>
<td>Judging or Perceiving</td>
<td>How a person deal with the external world</td>
</tr>
</tbody>
</table>

The various combinations of these preferences result in a total of 16 personality types and are typically denoted by four letters to represent a person's tendencies on the four scales. For example, ENFP stands for Extroversion, Intuition, Feeling, and Perceiving.
In choosing the most appropriate learning style model it is important to realize which one can be the best used specifically in e-learning and how the particular model will affect the rest of the
personalization features. Student personality is just one point in personalization of e-learning. It is oriented to the learner and on how to achieve the best results. But e-learning also has another side – course material, its structure and annotation.

4 Semantic web
Another important direction in personalization of e-learning is course content management. For this topic different approaches exist, but the most popular in Internet and e-learning is semantic web which will be also used in this research.

Semantic web approach is focused on the use of ontology. In the field of computer science, ontology is "a shared and common understanding of some domain that can be communicated between people and application systems" [18]. According to Daconta [19], an ontology is represented by several components, namely:

1. Classes or concept, general things in the domain of interest,
2. Instances or individual, particular things,
3. Properties and value of the things,
4. Constraints and rules of the things,
5. Relationships between the things and
6. Functions and processes involving the things.

In semantic modeling, ontology is represented by standardized languages which are RDF, RDFs or OWL[20]. Usage of ontology structure helps create contextual links between keywords of course material and also provides possibility to take account other properties of personalization, such as student learning style, previous knowledge, available devices etc. It also saves students time by more precise content matching to keywords and related materials.

Many different technologies have been developed to solve these challenges and assist to student.

5 Technological approach
New technologies give new possibilities for communication to make information exchange process comfortable and accessible. This statement also applies to e-learning.

According to the technology which has been utilized in the training process, can be distinguished e-learning, m-learning ant t-learning (learning through television). [21]

Most popular and accessible technological solution for e-learning is based on web technologies and using computer, but wireless and mobile computing have resulted in mobile education or m-Learning. M-learning is widely defined as learning content delivery to the students via mobile devices. [22]

With wireless and mobile technologies, it is possible to realize anytime, anywhere, anyway, any device for learning and educating. Implementation of the m-Learning involves adding mobile computing efficient implementation of such a learning technologies into the old e-Learning system. [23]

Technological approach in the context of personalization is how learning process will be ensured independent of device used. And the other challenge for e-learning developers will be how to integrate all functionality of these widely distributed new technologies into learning process.

6 Framework for personalized e-learning
Authors already in their previous research try to made some steps towards e-learning personalization. The model for e-learning methods development, which allows simulating the effectiveness and students' satisfaction of different learning methods were prepared and approved in Vidzeme University of Applied sciences.

The model was based on classical Kaschek web-based e-learning course model [24] supplemented with technological layer (See Figure 2).

From the top to the bottom model identifying a definition layer, a technological layer, a didactic layer, a tutorial layer, a presentation layer and an implementation layer.

As a result of this research the model of e-learning methods development has been created. To represent simulation model as close as possible to real life situation system dynamics tool Stella 9.0.3 has been used.

E-learning methods development model, realize simulation of several processes:

- Simulation of available technologies-this part imitate the existence of each technology
for each student, based on probabilities, which are subordinated to the model,

- Simulation of perceptions distribution-this part simulate existence of each student's perception and count the number of each type students in course,
- Simulation of learning methods technological practicability-this part of model determines is it possible to realize certain learning method using available technologies,
- Simulation of students stored knowledge units using each of learning methods-this sub-model established effectiveness for learning method, simulating stored knowledge units for one student and all group.
- Simulation of enjoyment using each learning method-this sub-model simulating “enjoyment” unit’s accumulation rate in course using one or the other learning method. [25]

This research showed perspective of adaptive e-learning and was a first try for authors to personalized e-learning development, but there was also some disadvantages which need to be improved:

- as a learning style model VAK was used; it is not the best one because it helps to set just perception type, but not students personal and learning habits.
- used learning methods was selected based on most listed methods in literature and its support for different perceptions.
- rapid technological development; new electronic devices which can be used for e-learning have been developed and this model and used methods no longer proved maximum use of available technologies and their functionality.

To take account all new personalization aspects, the new framework for personalized e-learning need to be developed.

Framework will be based on four basic personalization blocks: student personality; knowledge level; course content and technologies. Each of blocks targets a different aspect of personalization, therefore it is possible to achieve the broadest level of personalization.

6.1 The block of student personality
Stores information about student learning style and previous knowledge level. For determine students learning style the Myers-Briggs type indicators will be used because it can not only indicate the learner’s preferences, but also indicate, how clear in expressing the preference for a particular people over its opposite and this approach can give more significant result. Once the student's preferences are determined, the teacher can adapt the method for presenting the material and questions and thus raise the learning level.

6.2 The block of student knowledge level
Ensure searching according to specific students' needs. To provide effective searching the tree of concepts needs to be created. The structure of concept tree is based on ontologies and after searching students get a list of learning units in order of priority.

6.3 The block of course content
This block is responsible for structure of course material.

All course material is divided into small, independent units of information - Learning Objects. They are the appropriate technology for the development and exchange of different types of information and can be combined in different contexts and technologies.

6.4 The block of technologies
Technologies block is responsible for technological personalization. Thanks to structure and size of learning objects, it is possible to read them on different devices independent of display size and Internet connection.

It's recognize device from which the request comes and sent personalize course content to specific user device.

7 Conclusion
The goal of this paper was to present theoretical justification of different aspects of personalization and give a framework for personalized e-learning development.

The proposed framework allows to look at the topic of personalization of e-learning as widely as possible taking into account the student's personality and the available equipment, and also paying attention to the structuring of course content and its presentation.

E-learning development is very closely linked to technological development. As technologies and their functionality grows, course creators must continuously work at e-learning material development and quickly respond to changes.

Another approach is based on the perspective of technological development by creating course materials, which are easy to adapt and use on different devices from the beginning.

Future work will be related with reuse of knowledge
management principles in e-learning and development of personalized e-learning knowledge transfer model using effective methods of ontology.

References: