Improvement of personalized e-learning model framework using principles of knowledge management

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Abstract: 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. Therefore rapidly increase attempts to adjust e-learning process for individual needs and to adapt in e-learning systems best practice of other scientific fields. One of the ideologically closest direction of science is knowledge management (KM).

The aim of this article is to give theoretical background for adaptation of knowledge management principles in improvement of personalized e-learning model framework using effective methods of ontology and meta data standards.

This research offers a theoretical background for practical personalized e-learning model development.

Key-Words: - e-learning, personalization, knowledge management, meta data, meta-knowledge, ontology.

1 Introduction
Since the end of last century the Commission of the European Community has been actively advocating for study possibilities using modern technology and lifelong learning. This initiative resulted in the Memorandum of Lifelong Learning to prepare the way for objectives to achieve in coming years. There should be found new ideas and ways how to give another momentum to lifelong learning. Enhanced ways of teaching and learning such as e-learning and m-learning probably could cover the gap in education and lifelong learning accessibility. But there is still the biggest problem of e-learning - 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, personalization and different science directions adaptation. [13]

Research confirms that every student acquire training material based to their own unique learning style, needs and interests. [1] Currently used e-learning platforms generally do not include characteristics to provide personalized learning approach and the same materials and activities are shown for all students. 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 [2], [3].

Personalized learning and teaching could be regarded as the highest level of training. Confucius, a great thinker, philosopher and educationist of China, presented a philosophical statement about 3 000 years ago.[4] His philosophy in teaching is known as: “teach students in accordance with their aptitude, adjust measures to local conditions” [5].

Personalization in the context of computer science refers to the ability of a system or application to adapt the needs of each user. 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.[6]

With increasing popularity of personalization idea, also increase attempts to adapt in e-learning systems best practice of other scientific fields. One of the ideologically closest direction is knowledge management (KM). Also, the e-learning can largely be considered as KM. Traditionally, KM understand as the managment of company's knowledge, but in learning process students public knowledge are managed. The joint studies of KM and e-learning point out the same fundamental goal: facilitating organizational
learning. Researchers try to analyze the similarity of the goals, methods of assessment, and some knowledge sharing processes both in KM and e-learning. An e-learning system within KM is traditionally analyzed as a knowledge resource repository, where the KM methods can be implemented to increase the effectiveness of knowledge dissemination [7]. Conversely, to ensure the display of personalized knowledge a semantic network and ontology ideas has been used. Ontology has recently gained popularity in building knowledge base because the description, localization and effective reuse of software patterns and systems of patterns can be approached through an ontology-based formalism.

The aim of this article is to give theoretical and practical background for adaptation of KM principles in e-learning and improvement of personalized e-learning model framework using effective methods of ontology and meta data standards.

The structure of the paper is as follows. In Section 2 will be presented the concept of knowledge management in e-learning. Section 3 and Section 4 will give theoretical background for personalized e-learning model development using principles of KM and used meta data standards. In Section 5 will be given practical use of effective methods of ontology for personalized e-learning model development, but in Section 6 concluding remarks and future work will be given.

2 The concept of knowledge management in e-learning

It is more and more popular to make interdisciplinary researches. A number of recent studies have contributed to KM and e-learning integration.

Different researchers have used different approach to define KM in their literature. Singh et.al.(2006) classified them with different theoretical perspectives namely Need of KM, What KM demands, KM practices, KM and IT, KM processes, and Holistic nature of KM. [8] In this paper viewpoint of KM as process will be discussed and KM will be defined as a process of knowledge creation, validation, presentation, distribution, and application. [9]

Table 1. Dimensions of knowledge

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Traditional view</th>
<th>Integrated context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>answers</td>
<td>Students data, learning materials</td>
</tr>
<tr>
<td>Meta-data</td>
<td>data attributes</td>
<td>Profile and model parameters</td>
</tr>
<tr>
<td>Information</td>
<td>about e-learning</td>
<td>Structure of model, profile</td>
</tr>
<tr>
<td>Knowledge</td>
<td>learning materials</td>
<td>Information on how to present the material of learning courses to the users</td>
</tr>
<tr>
<td>Meta-knowledge</td>
<td>keywords, material A is a part of course B</td>
<td>Knowledge on what (or how) learning material should be presented to the student with the particular characteristics and what should not be presented</td>
</tr>
</tbody>
</table>

Beside this division into data, information, and knowledge the concept meta is often used with data and/or knowledge. Meta data in this case is used in the ordinary meaning “data about data” and meta knowledge here is interpreted as contextual knowledge. In Table 1 these concepts are in the rows of the table while in the columns the traditional view with e-learning systems and a new view related to the context of adaptive e-learning systems has been given.
This adaptation shows potential of KM and e-learning processes development. In previous research authors already try to made some steps towards e-learning personalization and identified different directions of personalization. To provide insight into the author's previous research and identify applications ways of KM, in the next section theoretical framework for personalized e-learning model will be discussed.

3 Personalized e-learning model development using principles of KM

In authors previous research 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.[13]

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. Therefore weaknesses were improved and theoretical framework for personalized e-learning model were developed. Theoretical framework is based on four basic blocks of personalization (see Figure 2): 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.

![Diagram of four blocks of personalization in e-learning](image)

**Fig.2 Four blocks of personalization in e-learning**

**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.

**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.

**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.

**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 personalized course content to specific user device.[6]

In perspective of KM usage there are possible to improve student knowledge course content and technological blocks. These improvements are based on standardized learning objects and technologies descriptions.

The basic advantage of learning objects structure is that for the student, who has the sufficient background (an “advanced” learner), an e-learning system can present a brief summary of that material and hyper-links to the more detailed description of it. In the case when the subject is unknown to the student (a “novice” learner) an e-learning system may present more detailed information in a smooth logical flow. In this example the information on how to present learning material in brief and detailed form is knowledge, while the context, which specifies the situations where each of the presentation forms should be used, is meta-knowledge or contextual knowledge.[12]

This type of structure provides personalization according to student's previous knowledge level and make e-learning process more efficient and also helps to reduce time for course material learning. In KM as well as in e-learning one of the main problems is storage and re-use of the knowledge that is accumulated with experience. Re-use of the knowledge is important to improve course quality and discover students habits in learning process. In e-learning systems such knowledge can be accumulated both by the system itself and by the participants of the e-learning environment. For example teachers can analyze students' performance as well as the statistics of students’ interaction with the e-learning system (e.g., how long the student has
studied certain material, or how many mistakes were made in the test, etc). This knowledge allows the teacher to restructure the learning material, and to refine learning scenarios and test tasks.[12]

In order to provide a unified description of the information and its use in e-learning personalization, various meta-data standards have been established, therefore in the next section some of the most used will be described.

4 Meta data standards

Vocabulary overlap and link naming impact the construction and use of concept maps to represent knowledge. Research suggests that different people choose the same word to represent the same object less than twenty percent of the time [14]. Some concept mapping research uses closed lists of concepts [15]. Most of the current concept mapping tools allow users to choose their own concept and link names [16]. However, the benefit of using a closed link system, in which users select from a list of link names, has been discussed in the literature on knowledge representation, learning evaluation, and critical thinking [17]. There is a growing consensus among researchers that links should be named, modifiable, directional, and represented by canonical sets.[11]

Meta data standards for the Internet are an attempt to bridge the gap between the comprehensive cataloguing which is done by professionals in the library context, and the free-for-all of document creation on the Web. In particular, these meta-data standards allow creators of documents and managers of resource collections to describe resources in a detailed manner facilitating targeted queries by search engines.

There are three main types of meta data:

- Descriptive meta data describes a resource for purposes such as discovery and identification. It can include elements such as title, abstract, author, and keywords.
- Structural meta data indicates how compound objects are put together, for example, how pages are ordered to form chapters.
- Administrative meta data provides information to help manage a resource, such as when and how it was created, file type and other technical information, and who can access it. [18]

The best known meta data standard is Dublin Core. The original objective of the Dublin Core was to define a set of elements that could be used by authors to describe their own Web resources. Faced with a proliferation of electronic resources and the inability of the library profession to catalog all these resources, the goal was to define a few elements and some simple rules that could be applied by non-catalogers. The original 13 core elements were later increased to 15: Title, Creator, Subject, Description, Publisher, Contributor, Date, Type, Format, Identifier, Source, Language, Relation, Coverage, and Rights.[18]

To describe e-learning course content special meta data standard - Learning Object meta data, has been developed. The IEEE Learning Technology Standards Committee (LTSC) developed the Learning Object meta data (LOM) standard (IEEE 1484.12.1-2002) to enable the use and re-use of technology-supported learning resources such as computer-based training and distance learning. The LOM defines the minimal set of attributes to manage, locate, and evaluate learning objects.[18]

The attributes are grouped into eight categories:

- General, containing information about the object as a whole;
- Life cycle, containing meta data about the objects evolution;
- Technical, with descriptions of the technical characteristics and requirements;
- Educational, containing the educational / pedagogical attributes;
- Rights, describing the intellectual property rights and use conditions;
- Relation, identifying related objects;
- Annotation, containing comments and the date and author of the comments; and
- Classification, which identifies other classification system identifiers for the object.

Some elements of Learning Object meta data will be used to create learning objects concept tree based on ontologies.

5 The use of ontology in e-learning

One of the key issues in developing an e-learning course is the organization of the learning resources. A good organization of such resources allows the users to easily discover and access new resources. [19]

Ontologies allow to specify formally and explicitly the concepts that appear in a concrete domain, their properties and their relationships. Furthermore, they are useful in many environments: and especially in educational environments, as they enable people and/or software agents to share a common understanding of the knowledge structure. [20]
In semantic modeling, ontology is represented by standardized languages which are RDF, RDFS or OWL[21]. Ontologies can be an important support both for the course building phase and the learning phase. In the course building phase ontologies support teachers in the activities of analysis and semantic annotation of learning objects and the definition of a teaching course. A course, from a conceptual point of view, is seen as a path over the graph that models an ontology. In the learning phase ontologies support students in following a course from the eLearning platform. Students may follow the given learning path, or may dynamically modify it [19]. In this research ontologies will be used to create concept tree of learning objects and to detect previous knowledge level and used technology. A learning object is anything digital that can be delivered across the network on demand, be it large or small (text, images, audio, video, animations, applets, entire web pages that combine several media types, and so on). In the description of a learning object, there are two important characteristics included to get adaptation:

- the appropriate learning style and,
- the features of the device to display learning objects correctly.[20]

Figure 3 shows possible uses of ontology in each of personalized e-learning model aspect. To describe the learning objects meta data will be used - some elements of the IEEE LOM an internationally recognized and adopted standard [22].

The Myers-Briggs learning style model has been selected to describe the learning style that best fits an object, as LOM does not manage this issue. The Myers-Briggs inventory is based on Carl Jung's theory of types, outlined in his 1921 work Psychological Types [24]. Jung's theory holds that human beings are either introverts orextraverts, 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:

- Extraversion or Introversion;
- Sensing or Intuition;
- Thinking or Feeling;
- Judging or Perceiving;

The various combinations of these preferences result in a total of 16 personality types.[6]

Combining all previously viewed ways of personalization, knowledge management process, ontologies and meta data standards it is possible to create more advanced personalized e-learning model.

6 Conclusion

The goal of this paper was to present theoretical background for use of knowledge management principles in improvement of personalized e-learning model using effective methods of ontology and meta data standards. Proposed ideas allows to adapt knowledge management principles to improve personalized e-learning processes and look at the topic of personalization of e-learning even more widely. This is very important, because more and more developed inter disciplinary scientific directions and old boundaries between scientific disciplines are breaking down.

Personalized 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 on. The use of ontologies for description of learning objects and technologies will help to avoid problems with incompatibility between devices.
Future work will be related with practical development of personalized e-learning model using effective methods of ontology and pilot project implementation in Vidzeme University of Applied sciences.

References


[13]适当的参考文献...


