NETWORK TECHNOLOGIES FOR E-LEARNING

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Abstract: *In this paper are presented some conclusions on the selection of the LMS to be used. The results of this study give readers information to make their own decisions when choosing an LMS platform based on the needs of their institution. The process of LMS selection is a multi-criteria decision-making problem and an Analytical Hierarchy Process (AHP) was used to assist in building the model and draw decisions. The paper presents an environment "Network technologies for e-learning"(NTEL) using the offered Model for describing, structuring, and organizing the ontological representation of learning objects through providing a semantic infrastructure. Strategies and methodologies in ontology development and implementation are also discussed.*

Keywords: LMS, LEARNING OBJECTS, ONTOLOGY, AHP

1. Introduction

The main goal of the research is to describe and structure ontology based learning objects and use for developing a uniform learning support environment considered with the requirements of the existing Learning Object Metadata (LOM) of IEEE Learning Technology Standards Committee (LTSC) [7] and the specification suggested by the Instructional Management System (IMS) [8].

The most serious problems are caused by the semantic evaluation process. There is a great variety of LMS. As far as evaluation is concerned, current platforms may be helpful to acquire tacit knowledge in organizations, but they do not solve the problematic of doing automatic semantic information. Thus, cooperative cognitive processes are not efficient and not found matching between LOs and student information. This makes the learning process to be impersonal, and not many users can keep track properly of their students' progress [1].

A possible solution might include a component model for network technologies for e-learning and its applications in NTEL to deal with this issue.

2. A Component Model for Network Technologies for e-Learning

The Component model for network technologies for e-learning was developed on the grounds of the existing standards, specifications and ontologies for creation, management, development, and interchange of learning objects and means and the existing instructional design theory. The key aspects of the learning support environment "Network technologies for e-learning" (NTEL) have been presented in the following components of the model:

2.1. A model for describing, structuring, and organizing the ontological representation of learning objects

Figure 1 depicts the composition of the model and the relationships between its modules. At the top of the figure, the Learning object is connected to the Metadata and Knowledge. The Standard Learning Object Metadata (LOM) contains various metadata describing the learning object. The LOM categories are connected with module Categories. A learning activity could be published (using LOM) and integrated in a learning object instructional sequence. A learning object can be created to be used in different courses, and its content can be created on many ways (e.g. using text editor, slide presentation creator, HTML editors, graphical tool, domain applications, etc.). Once created a learning object with its ontology-based content can be included in different courses [3]. We use LOs when a new instructional design is being constructed.

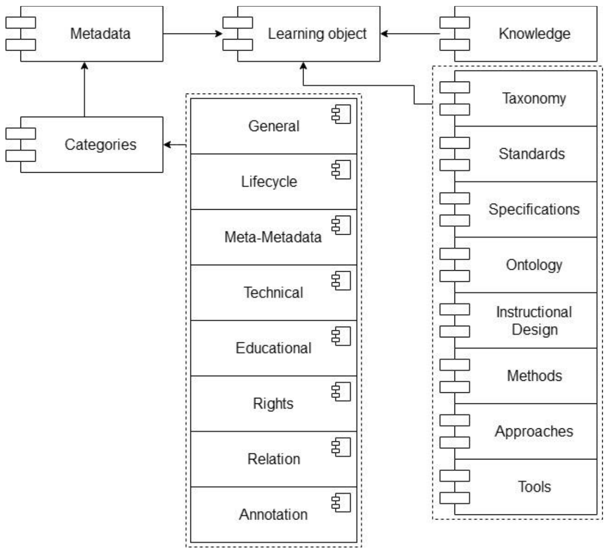

Fig. 1 *A model for describing, structuring, and organizing the ontological representation of learning objects*

2.2. Standards in Learning Object Ontology

In conformity with the IMS specification the environment content package includes two components – an XML file describing the course structure, called imsmanifest.xml and the physical files forming the course structure.

The XML manifest file consists of the following components: meta-data, organizations, resources, and a sub-manifest of each separate environment course. The meta-data are used for describing the content package and its characteristics in particular. The characteristics suggested by the Learning Object Metadata Standard are used in the environment grouped in the following order: general, lifecycle, meta-metadata, technical, educational, rights, relation, annotation, and classification categories. The learning objects stored in the Learning Repository can be found using the metadata. The organizations component shows the systematization of the course content. It includes several subcomponents describing the separate elements of the course. It does not include a description of the physical files but ensures an information work frame guiding the user in the consecutive implementation of particular actions.

The resources component describes the physical files used in the learning course and the relations between them. It shows features different from the organizations component.

The physical files include the following content: a course information, a theoretical material, tests, simulations, games, an interactive editor, and a glossary.

The IMS specification [8] allows placing the content package in the Package Interchange File. It is a single compressed file which can be used in different learning systems. By packaging the separate courses of the learning support environment presented in the research they can be used independently in learning management systems.

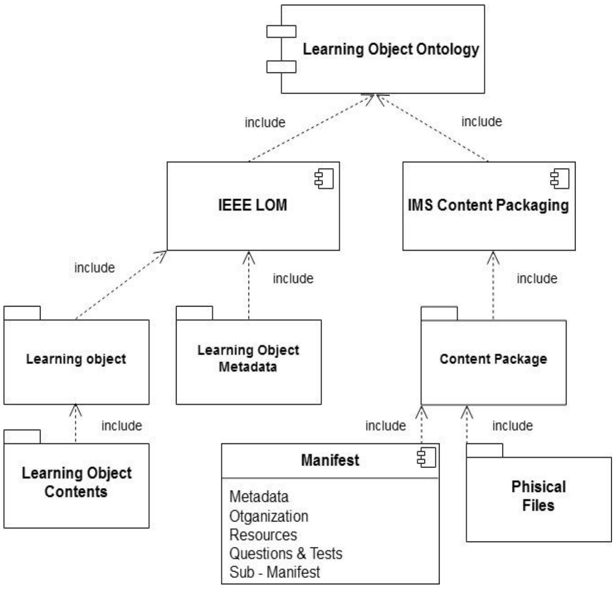

Fig. 2 *Standards in Learning Object Ontology*

We have designed and implemented a LOM ontology that establishes an intermediate layer offering a shared vocabulary that allows specifying restrictions and gives a common semantics for any application which uses Learning Objects Metadata. LOM aims at the abstract description of learning objects by providing an interoperable form and vocabulary for semantic learning objects description and discovery in repositories. Some of the technical aspects in the domain and instruction model provide input for the transformation to LOM. An ontology of a specific domain for a learning objects repository serves as a map and suggests paths for retrieving candidate learning objects to reach a certain objective of learning or teaching [1].

2.3. Application of Instructional Design for ontological organization of e-learning

The IMS Learning Design specification (IMS-LD) provides a model of semantic notation to describe both the content and processes of units of study. This specification is based on: a well-founded conceptual model that defines the vocabulary and the functional relations between the concepts of the LD; an information model that describes in an informal (natural language) way the semantics of every concept and relation introduced in the conceptual model; a behavioral model that specifies the constraints imposed to the software system when a given LD is executed in runtime [8].

The Learning Design has a number of components used to describe the learning process: the execution entities to be carried out, which can be *Activity* or *Activity Structure* (groups of activities that will be executed in sequence); the *Role* that participate in the execution of those activities as instances of the *Learner* and *Staff* concepts; and the *Environment* that describe the educational resources to be used in the activities (Fig. 3). These concepts constitute an exhaustive and disjoint partition, because an instance of a component must necessarily be an instance of one of its subclasses.

The Learning Design is related to the *Method* concept, which describes the dynamics of the learning process (Fig. 3): a method is composed of a number of instances of the *Play* concept that could be interpreted as the *runscript* for the execution of the unit of learning. All the play instances have to be executed in parallel, and each one consists of *Act* instances, which could be understood as a *stage* of a course or module. The *Act* instances must be executed in sequence (according to the values of the execution order attribute), and they are composed by a number of Role Part instances that will be executed concurrently. A *Role* Part associates a *Role*(s) with an execution entity to be carried out in the context of the *act*. Every execution entity requires an *Environment*, which manages Learning Objects as resources The execution of an act consists on the simultaneous participation of roles in an activity or group of activities, and once the activities are completed, the associated roles could participate in the execution of any other activity through different role part instances. The Activity has two subclasses: the Learning Activity and the Support Activity. A Learning Activity includes an educational activity that uses a relation with the Prerequisite and the Learning Objective. The Support Activity is introduced to facilitate a learning activity [6].

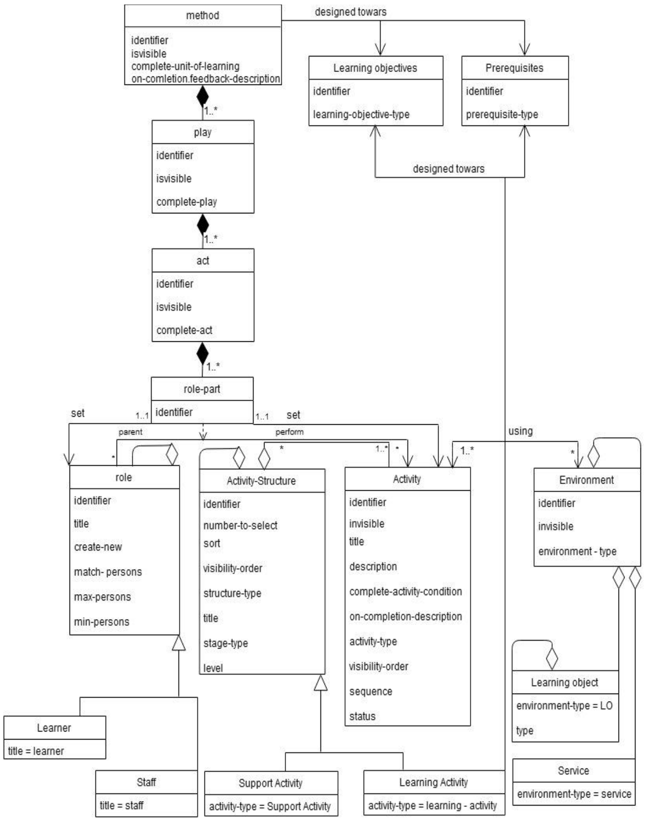

Fig. 3 *Application of Instructional Design for ontological organization of e-learning*

2.4. Web based learning support framework with scaffolding

The processes of supporting e-learning are presented on the fig.4.

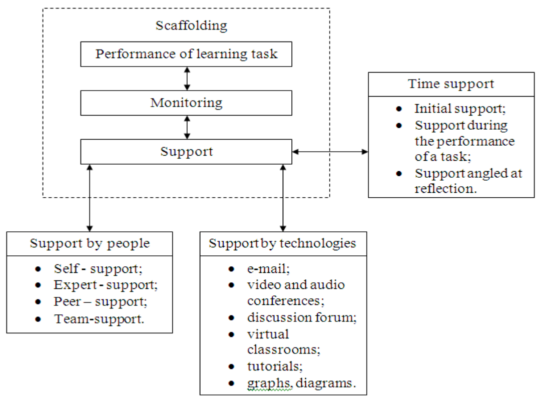

Fig. 4 *Web based learning support framework with scaffolding*

The support has been an effective and intensive way for individuals on users group to learn about the consequences of his behavior, for users group to improves its effectiveness, and for organization to monitor learner progress. Users receive on-going support from their personal tutor. When problems in task performance are expected and known beforehand, place support for these problems in the learning environment, so that the NTEL instead of the mentor becoming the main source of just-in-time support.

These decision aspects, provide a model for the categorization of learning support used in this research.

2.5. A model for E-Learning Network Technologies

The LMS must be guided by instructional design approach. This model (fig. 5) is theoretically motivated by socio-cultural approach and cognitive apprenticeship model for each element of the learning environment. While each form of scaffolding provides support, each differs in the level of social support, collaboration with peers and type of feedback offered. These forms of scaffolding with technology researchers are now developing more principled and innovative forms of instructional design to guide the process.

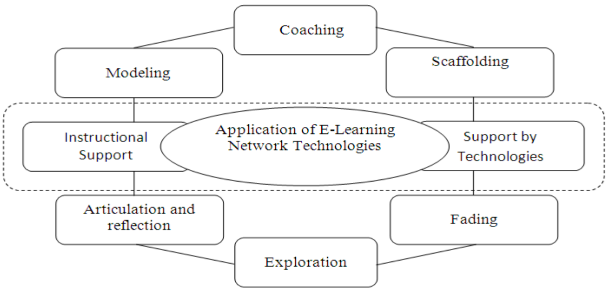

Fig. 5 *A model for E-Learning Network Technologies*

3. A multi-criteria decision-making approach

In recent years, most educational organization have preferred to use open source LMSs. They have to decide which LMS is suitable for them. Problems have been experienced when determining the features to be considered in selecting the most suitable LMS for their institutions due to the high number of LMSs available with different specifications. This has created a multi-criteria problem, which can be solved using a multi-criteria decision making approach (MCDM) [5].

Table 1 *Summary of applications of the DM techniques [4]*

Метод	Честота на приложение	Процент
AHP	128	32,57%
ELECTRE	34	8,65%
DEMATEL	7	1,78%
PROMETHEE	26	6,62%
TOPSIS	45	11,40%
ANP	29	7,38%
Aggregation DM methods	46	11,70%
Hybrid MCDM	64	16,28%
VIKOR	14	3,56%

The selection process is based on a literature review and classification of international journal articles from 2000 to 2014 [4]. MCDM provides strong decision making (DM) in domains where selection of the best alternative is highly complex. MCDM method has been applied to many domains to choose the best alternatives. Where many criteria have come into existence, the best one can be obtained by analysing different scopes of the criteria, weights of the criteria, and the selection of the optimum ones using any MCDM techniques. Table 1 shows frequency of MCDM techniques and approaches. Based on the results presented in this table, a total of 393 studies have employed DM techniques and approaches. Table 1 and fig. 6 shows that AHP method (32.57%), and its applications have been used more than other tools and approaches.

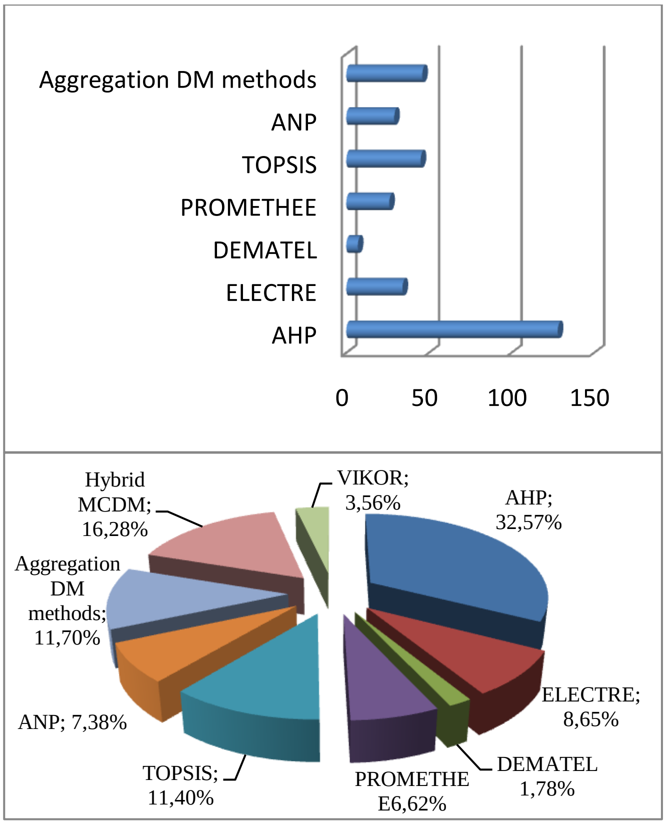

Fig. 6 *Frequency of MCDM techniques and approaches*

Steps of LMS selection process of effective system are [2]: determination of the affecting criteria,questionnaire collection and statistical analysis, weighting these criteria, evaluation of the entire performance according to these weighted criteria. We compare three LMS (Sakai, Moodle, NTEL) with AHP Process. The evaluation criteria used in this study are: usability, accessibility, compatibility, evaluation tools, portability, reliability, sustainability, and user satisfaction. Reveal that which LMS is best, when altered the weight of evaluation criteria values for main object. According to giving priority to criteria weight, the application allow to find best choice (NTEL) and worst choice (Sakai) from all results shown in fig. 7.

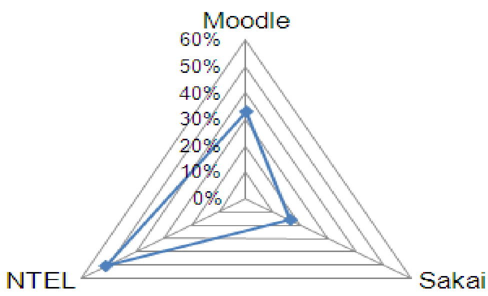

Fig. 7 *Comparison of LMSs*

NTEL provide instructors with support for activities, such as preparation of learning content, structuring and organization of the content in accordance with the chosen teaching strategy, interactions with coordination of users' activities using online communication tools, that allows learners to collaboratively create and share knowledge. The information coming from users, for instance, how other users have tagged or commented a piece of learning content is an important factor in increasing learner interest.

4. Conclusion

In this paper, we present a learning design ontology based on the IMS LD specification and the LOM standard for metadata. In ontology, the IMS LD elements are modeled in a concept taxonomy in which the relations between the concepts are explicitly represented. The model suggested for structuring the learning objects can be applied as a whole or in separate parts of the learning assistance media which can be set by the teachers themselves without the intervention of the development teams.

The structures obtained as a result of the model application can be very useful at the development of learning management systems through developing a uniform "frame" of the system and its including in a particular semantics can be done later.

It is so important to carry out all types of comparisons, presenting the strengths and weaknesses of the different LMS. According to the AHP method the best solution seems to be the NTEL system.

5. References

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