A model of an ontologically based e-Learning environment

Hristo Tuzharov, Chavdar Marchev

Abstract: *In this paper we present an ontologically based e-Learning environment (OBEE). Briefly, we explain the function of ontology to surmount difficulties in communication, its characteristics and applications. We view the basic objects in E-learning, their structure, interaction and characteristics. Finally, a common functional model of an OBEE is presented. It is paid attention to the processes of conversion the data into knowledge using OBEE. The basic learning objects used in the environment are resented, their internal structure, interaction and characteristics. Functional and conceptual models of the environment are presented.*

Key words: *ontology, terms, tacit knowledge, explicit knowledge, learning object, information object, content element, information object, metadata, XML, LCMS*

Introduction

Nowadays, a rapid development of information society is observed. The methods of work, the way of life and the interrelations are changing dynamically. There are new paradigms and conceptions which form long term strategies for social development.

The system of education has an important role in the development of those processes. It is one of the major factors determining how and how much the members of the information society will be adapted to the new conditions of life and will be able to participate effectively in its construction and development.

In the paper we consider the facilities of an OBEE in the realization of the new concepts in the process of education.

Knowledge codifying

At the heart of Nonaka's work is the premise that there are two types of knowledge: tacit and explicit. Tacit knowledge is subjective and experience based knowledge that can not be expressed in words, sentences, numbers or formulas, often because it is context specific. This also includes cognitive skills such as beliefs, images, intuition and mental models as well as technical skills such as craft and know-how. Explicit knowledge is objective and rational knowledge that can be expressed in words, sentences, numbers or formulas (context free).

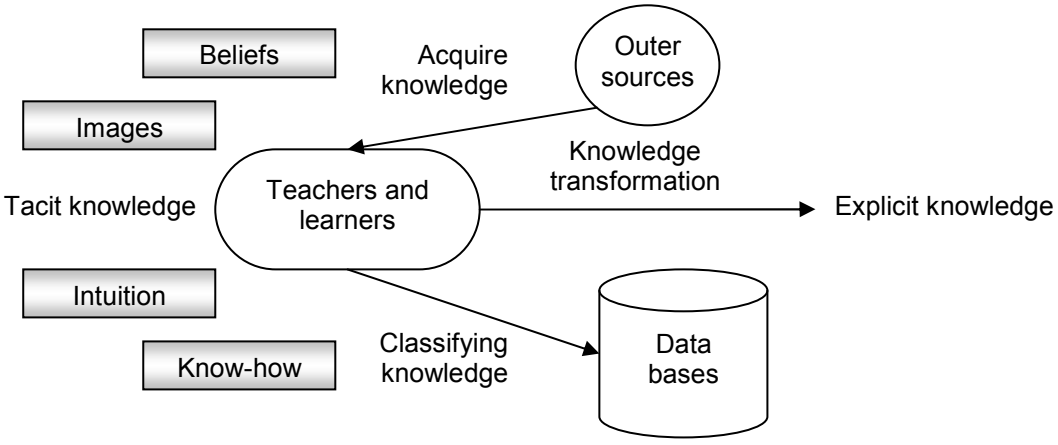

fig.1 Knowledge transformation at the time of learning process

The considered OBEE takes part in the process of converting the tacit knowledge in explicit regarding to every learner. The data which comes from outer sources is adapted

by teachers by means of the relevant modules. The purpose of this adaptation is to make learning process easier for perception by the students (fig.1). Parallel with adaptation the knowledge is systematized and stored into ontologically based repositories. In contrast to the first process, the second is automatically done by the system.

Learning ontology

People cannot share their knowledge if they don't speak a common language [3]. Ontology is the science which gives a solution of that problem. Due to Ontology, the process of repeated and common use of knowledge can be simplified.

Always there is a thesaurus which is the base of the ontology. The thesaurus consists of terms which are taxonomically organized [1]. One of the main advantages of using ontologies in the knowledge management is the possibility to apply "system approach" in studying process. These are some positive aspects in using of the "system approach":

- *orderliness* – ontology gives an overall picture;
- *uniformity* – presented in such way subjects become easier to learn;
- *scientific character* – building an ontology allows authors to notice the missing relations between notions.

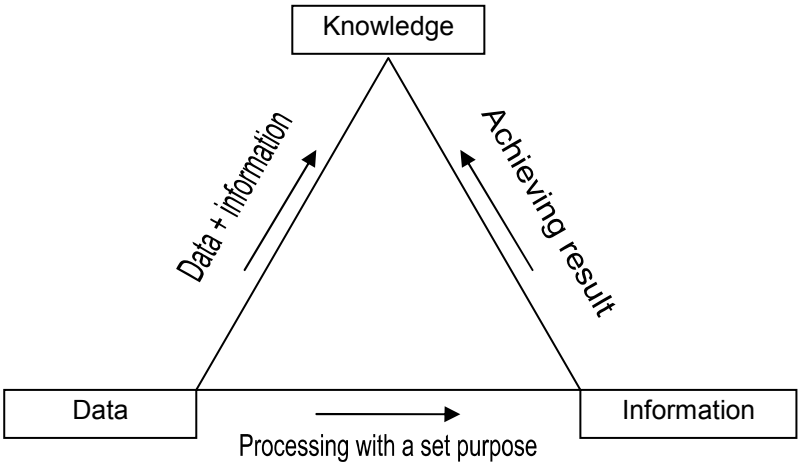

fig.2 Ontological triangle in e-Learning

The actuality of knowledge exceptionally depends on the information beneath it (fig.2). Regarding the knowledge management, OBEE can be considered as environment which converts incoming data into information and than, depends on the learner – in knowledge.

Functional model of OBEE

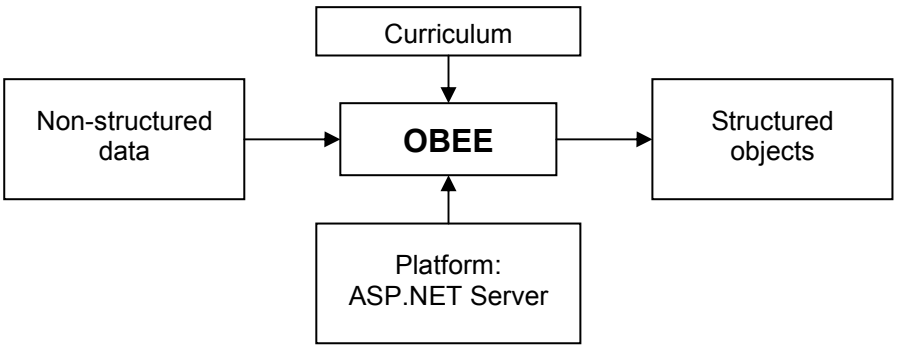

fig.3 Common functional model of the environment

By means of considered OBEE non-structured data is converted to structured objects which can be processed further (fig.3). This is the most important advantage of the LCMS (Learning Content Management Systems) over the LMS (Learning Management Systems). The considered environment is working upon Microsoft.NET Server. It can be reckoned as a complete system, but several important improvements can be done. Some of them are as follows:

- tracking the learner's path;
- adding asynchronous communication tools (forums, e-mail, ability to transfer messages);
- adding synchronous communication tools (chat, virtual classroom, whiteboard etc.);
- adding schedules, calendars, syllabus;
- maintenance of learner groups.

Data structure

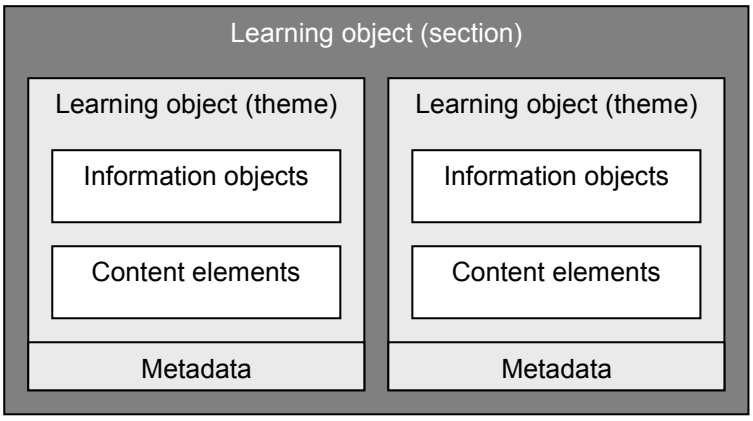

fig.4 Data structure

The products generated by OBEE (textbooks, manuals, tests and thesauri) are based on usage of the items listed below (fig.4):

- *Content elements* – Non-structured data (paragraphs, tables, lists), which are the building blocks of the learning objects of the lowest level (themes).
- *Information objects* – Indivisible objects (terms, operations, references, images, video, audio, etc.), without any educational significance. They can be used at the constructing of the themes. In contrast to the content elements they can be identified and classified.
- *Learning objects* – A unit which can be used in the learning process, teaching and improving qualification. Some of their characteristics are:
  - Small-sized (theme) or larger (section, module) which comprises the smaller learning objects (fig.5).
  - They can be embedded – embedded objects inherit properties and metadata from their parents.
  - As much the objects in the environment are smaller, the learning tool is much granular.

Products of the OBEE

The environment is designed as a tool for creating diverse types of learning objects: web-based textbooks, manuals, tests and thesauri (fig.5).

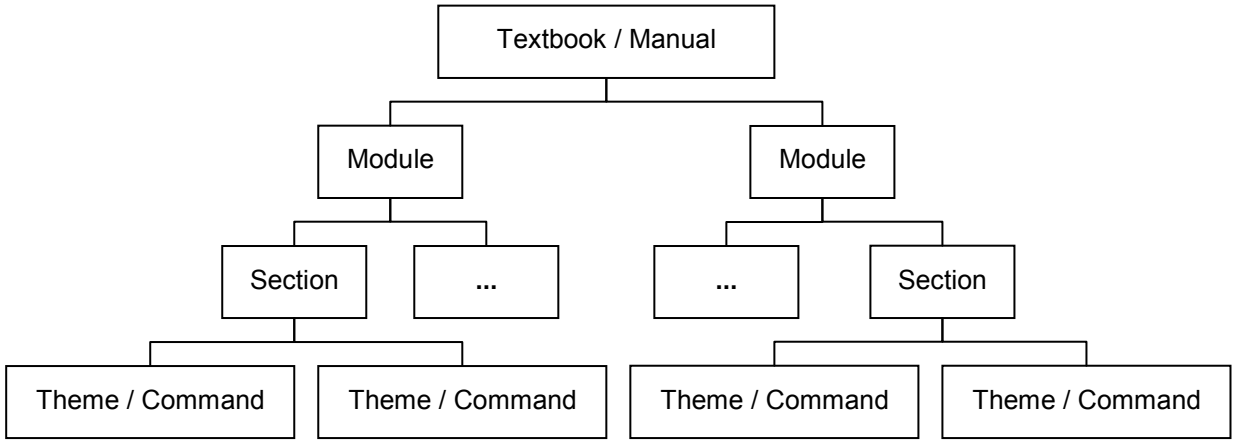

fig.5 Products of the environment

The hierarchical structure of the learning objects in textbooks and manuals is as follows:

- *Textbook* – a unit which is generated using already created themes, sections and modules. The textbooks which have been prepared are categorized in disciplines. Every textbook should have the structure mentioned above. It is impossible to avoid levels, because this cuts across the principles of the data model.
- *Manual* – describes multitude of commands, which serve to accomplish specific activity in certain area (e.g., manual which demonstrates MS Access usage).
- *Module* – corresponds to a part of textbook or manual and comprises several sections.
- *Section* – a chapter of the textbook or manual which comprises several themes.
- *Theme* – It is the basic building element of the learning tools. When a new theme is created, the author should classify it according to the existing hierarchical structure. Every theme is a combination of information objects and content elements.
- *Command* – a sequence of operations which leads to some decision (e.g., at manuals – the command "Copy")

The structure mentioned above is inapplicable to the rest products of the system (thesaurus and tests). These learning objects are automatically generated by the system when tutors are creating their textbooks and manuals. In spite of this they can be used independently, because the processing is done by different modules.

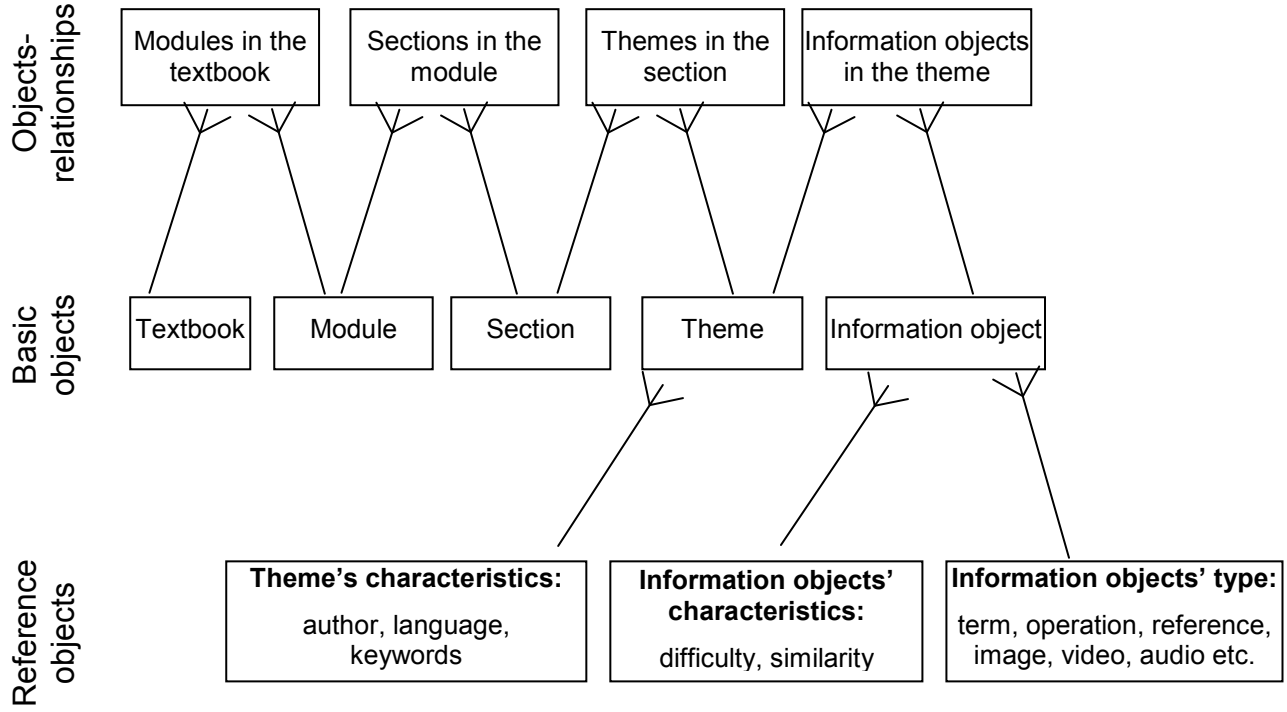

fig.6 Conceptual model of the process "Textbook creating"

Conceptual data model

A PER (Process-Entity-Relations) model of assist. prof. Tuzharov is used at the development phase of OBEE [2]. According to this model aforesaid objects are classified in four levels:

- *Object-process* – Conceptual model presented on fig.6 describes the objects which are related to the process "Textbook creating".
- *Basic objects (learning and information objects)* – It has been mentioned that the basic objects in the environment are three: learning objects, information objects and content elements.
- *Objects-relationships* – There are relationships of type „many-to-many" between some objects. Because of that reason "objects-relationships" are introduced. E.g., every textbook comprises several modules, but sometimes a module can be found in more than one textbook. The situation at sections, themes and information objects is similar. Thus the characteristic "reusability" of learning objects is achieved.
- *Reference objects* – They serve as metadata for the „basic objects". E.g, every term has level of difficulty (high, average, low).

Conclusion

The model of OBEE discussed in the paper, provides high possibilities for realization of learning environments, characterized by:

- granular content with numerous aims;
- various profile of the learners;
- individual trajectory of teaching;
- testing series of evaluation;
- teaching oriented to practice.

At present, there are two e-Courses: "Computer networks", and "Information systems", that can be found on the site of the application. They have the following important characteristics: modularity, connectivity and demonstrativeness. By means of metadata and the facilities of Microsoft ASP.NET technology it will add the following characteristics: functionality, regularity, aggregation and adaptivity to the teaching materials. As a result, the effectiveness of the process of learning will increase and respectively, better learners' results will be achieved.

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