ONTOLOGICAL MODELING OF ELECTRONIC EDUCATIONAL RESOURCES

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Abstract. The organization of educational information through innovative computing technology allows to move away from the linear organization of the learning space, thereby creating its "volumetric" analogue. In the modern view one of the effective means for the structural and logical construction of electronic educational resources as rather complex knowledge systems is ontology.

Ontology is an attempt at a comprehensive and detailed formalization of a field of knowledge using a conceptual schema which usually consists of a data structure containing all relevant classes of objects, their relationships and rules (theorems, constraints) adopted in a particular subject area. In world practice, for the clarity of ontologies, ontological graphs (ontographs) are used.

The presentation of information in the form of an ontograph makes it possible to display not only a single term (concept), but also to obtain all its semantic relationships with other concepts and categories, thereby comprehending its role in a given knowledge system or in solving a problem, showing the semantic effect of structural and logical organization of term fields.

The goal of this study is to summarize the results of our research, emphasizing the feasibility of ontological modeling of electronic educational resources (textbooks, manuals, simulators, etc.) using ontographs.

Indeed, the ontology O is a fixed logical construction of the form O = <X, R, F>, where X, R, F are finite sets, respectively, of terms (concepts), connections between them and functions that determine their interaction.

Since the set is finite, there is a certain superset that either coincides or contains the specified set of concepts and is described by a certain set of rules (laws, criteria). It is usually called a subject area. Thus, each separately taken electronic educational resource can be represented as a set of certain concepts of varying degrees of detail, between which links of a different nature are established. The paper presents the modeling of electronic educational resources as sets described by ontological graphs.

Keywords: electronic educational resource; ontology; ontological modeling; ontological graph; remote education

1. PROBLEM STATEMENT

The introduction of computer technologies, digitalization of the economy and the creation of an information society today cannot be imagined without remote education technologies. Despite this, the COVID-19 pandemic, which provoked massive quarantine restrictions and the unprecedented use of remote education technologies, revealed the reductance of the education system in many countries for long-term remote learning. Among the identified shortcomings were the psychological unreadiness of many teachers to work online, the lack of development of remote learning courses, the lack of adequate methods of interaction with students, etc. Among other things, it was revealed that the existing electronic educational resources do not fully cover educational programs, mostly they are outdated (their modernization does not keep pace with the

dynamics of the needs of the educational process), etc. In addition, many electronic textbooks and manuals are of dubious quality due to the use of outdated or unapproved terminology, lack of methodologies for developing resources of this type, and a number of other reasons.

On the basis of the above, the objectives of the study were determined:

1) search for new and modernization of existing approaches to the development of electronic educational resources;

2) creation of technology that allows non-professional programmers to create electronic educational resources (manuals, textbooks, collections) with minimal additional training;

3) presentation of the author's development on the use of semantic technologies for modeling electronic educational resources.

It should be noted that the use of programming languages such as OWL, as a rule, in the case of creating an EEP is not justified. For the first hand, because it puts forward quite serious requirements for the developer - he must know the programming language and be able to use it. For the second hand, many languages that allow working with ontologies are designed for use in a specific application and are not adapted for creating projects separate from the base site. There are also a number of features that slow down the application of the ontological approach to the creation of an EER. This is typically low user usability. As a rule, users want to see the result of creating educational resources in the familiar form of an electronic textbook.

2. ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Ontological modeling of electronic educational resources has been considered by a number of researchers. Thus, a technology for the development of educational content was proposed based on the application of the ontological approach and knowledge bases. (Krechetov, 2011) The same author shows the main advantages of using ontologies as a model for representing knowledge. The models and methods of individualization of e-learning were also considered in the context of the ontological approach (Muromtsev, 2020). The author proposes to use semantic models as a formal basis for individualized e-learning, including the apparatus of vector representations of knowledge graphs, which allows efficient processing of large and complex data structures, and also has the flexibility and expressiveness of an ontological approach. He considered existing technologies and ontologies for e-learning, modeling of an individual trajectory, semantic annotation of educational materials, methods of assessing knowledge in individualized learning, as well as ontological modeling of the cognitive profile of a learner.

Ontologies are widely used in education, as it is evidenced by many publications (Kudryavtsev D.V. 2010; Akharraz, L., Mezouary, A. E., & Mahani, Z. 2018; Stancin, Poscic, Jaksic, 2020) and many others.

3. STATEMENT OF BASIC MATERIAL AND THE SUBSTANTIATION OF THE OBTAINED RESULTS

For information to acquire practical value for the development of science and practice, it is necessary to reduce a variety of primary information to a form convenient for processing and interpretation. The solution to this problem is related to the task of representing spatial knowledge (Tsvetkov, 2013).

There are a fairly large number of ways to formalize knowledge, one of which is ontology. Let's define a basic set of concepts.

In informatics, ontology means explicit, i.e. explicit, conceptualization specification where the description of a set of objects and connections between them serves as a conceptualization.

Conceptualization here is understood as a description of concepts , as well as all information related to concepts (properties, relations, constraints, axioms, statements) necessary to describe and solve problems in a chosen subject domain (SbD). Concept - is a notion that reflects some concrete or abstract object of the real world. By SbD we