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## DEVELOPING A SYSTEM FOR ONTOLOGY-BASED DESIGN OF ITC ELECTRONIC COURSES

**Abstract.** A methodology for modifying computer ontologies (CO) in the field of information and communication technologies (ICT) is proposed by introducing into the formal CO a description of learning process technologies for high school or out-of-school institutions, as well as for professional retraining of specialists, which allows preserving and reusing the collective experience of education of this educational institution.

It is noted that the tool of the system of ontologized design of electronic courses (SODEC) partially implements this methodology, which automates the development of electronic courses and/or electronic textbooks (EC), reduces the costs and time of preparation of ET, ensures the relevance of EC to the current state of knowledge in the subject area (KSA) of ICT, accumulates personal materials of the teacher. It is concluded that for more effective use of the proposed methodology, it is necessary to develop a similar SODEC toolkit, taking into account the introduction of the corresponding COs into the ontology description language (OWL).

**Keywords:** electronic courses, electronic textbooks, computer ontologies, system of ontologized design of electronic courses, subject area, ontology description language.

### 1. INTRODUCTION

With the digitalization of modern society and the rapid development of information and communication technologies (ICT), which today are deeply integrated into almost all spheres of human activity, there has been a need to develop innovative methods and training tools at all levels of training. These methods and training tools should be focused on training specialists who will be able not only to process and analyze information materials, but also to effectively solve problems related to decision support in industrial design, classification of scientific and technical documentation, integration of information services of partner companies, etc. The beginnings of such competencies should be laid in high school, or in out-of-school institutions, for example, engineering and technical centers for youth, as well as during professional retraining of specialists.

**The problem statement.** To enhance the CO KSA of ICT, the study addresses the development of a methodology for designing CO processes that describe learning technologies for schools, training centers, and professional retraining, ensuring the preservation and reuse of collective educational experience.

**Analysis of recent studies and publications.** According to a number of experts, the relevance of research in this direction is due to such factors [1], [2].

Firstly, as in the general task of creating electronic courses and/or electronic textbooks (hereinafter we use the abbreviation EC), part of the knowledge of the subject area (KSA) of ICT and its relevance may be lost due to the increase in new information in printed form. This is not least due to the rapid pace of ICT development that is taking place today. Modern

schoolchildren should not only have knowledge in the field of ICT, but also in their subsequent activities become full-fledged specialists in their use.

Secondly, ECs KSA of ICT for high school or non-school institutions, as well as for professional retraining of specialists, have their own specifics [3], [4].. We are talking, in particular, about increasing the cognitive quality of EC, increasing the use of multimedia tools, interactive teaching methods, etc. Note that visual-figurative components are especially important in the worldview of schoolchildren, which encourages teachers to create EC in a visually expressive form, for example, by using multimedia.

Thirdly, the widespread use of personal computers (PCs) and other mobile gadgets (smartphones, tablets, laptops) in schools and in out-of-school institutions and professional retraining institutions. Moreover, in some cases, only PCs are not always suitable for the rapid processing of volumetric layers of material in individual ICT courses and disciplines. For example, when it comes to courses or topics "Mobile devices and networks", "Mobile Internet security", etc. This leads to a specific CO, characterized by the introduction of CO learning processes for a given KSA [5], [6]..

**The article's goal.** The research involved a systematic approach to KSA, structuring and the principle of hierarchy to KSA information, as well as an ontological approach to the design and development of EC, which is one of the applications of ontological engineering, in particular, the processing of terms and concepts contained in CO.

## 2. THE THEORETICAL BACKGROUNDS

The research involved a systematic approach to KSA, structuring and the principle of hierarchy to KSA information, as well as an ontological approach to the design and development of EC, which is one of the applications of ontological engineering, in particular, the processing of terms and concepts contained in CO.

## 3. RESEARCH METHODS

The relevance of this research is driven by three factors: the rapid growth of ICT knowledge requiring updated ECs to prevent knowledge loss; the need to enhance cognitive quality and visual interactivity in ECs for schools and training programs; and the widespread use of PCs and mobile devices, which demands specialized CO processes for modern ICT topics

## 4. THE RESULTS AND DISCUSSION

It is necessary to develop a process for designing the CO KSA of ICT, exemplified by the "Relational Databases" module, to automate EC/ET creation while integrating institutional experience and enabling ICT teachers to design content that connects database theory with programming and network fundamentals, considering the profile and needs of specialized school or out-of-school learners. In its formal form, the model of the designed CO will look the same as the general model of the CO KSA (1) [1, 16]:

$$S = \langle P, A, X \rangle, \quad (1)$$

Where corresponding sets  $P = \{p_i\}, i = (1, n)$  – processes for constructing EC and/or ET;

$A = \{A_j\}, j = (1, m), m \geq n$  – algorithms that implement these processes;  $X$  – entities (concepts) describing KSA.

However, in our case, the construction of a CO KSA with a description of processes will be simplified due to the absence of the need for semantic machine analysis of concepts.

However, the process of describing multimedia processes will become more complex. Although this complexity is present only at the initial stage of building a CO KSA.

SODEC is based on ontological knowledge, provides effective machine processing of the ontological description of knowledge, and provides automated filling of the EC with the necessary (according to the teacher's experience) structural elements of educational material. Such materials include multimedia objects. However, often these elements are not structured, not collected into an ontology, and there is no way to use them for other ECs.

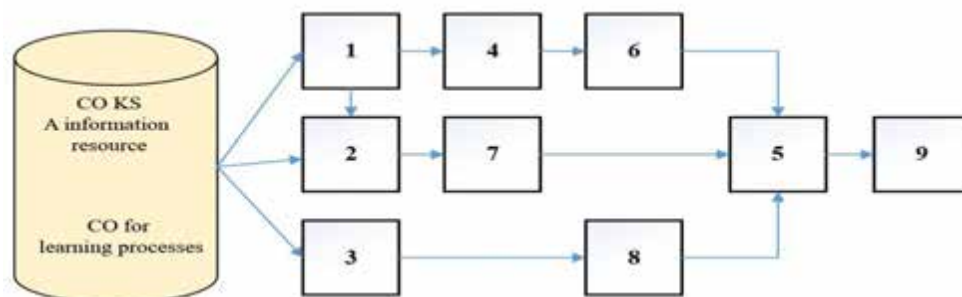


Figure 1. Scheme for preparing EC and/or ET (using the example of ICT (theme "Databases"))

The CO KSA includes concepts, concept descriptions, and CO descriptions of learning process algorithms. The author of the EC may decide to adapt descriptions or learning algorithms (for example, in order to simplify perception), which requires an appropriate mechanism in the EC compilation toolkit.

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