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Methodology of designing computer ontology of subject discipline by future teachers-engineers

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Abstract. The article deals with the problem of the methodology of designing computer ontology of the subject discipline by the future teachers-engineers in the field of computer technologies. The scheme of ontology of the subject discipline is presented in which the set of concepts of the future computer ontology and the set of relations between them are represented. The main criteria of the choice of systems of computer ontologies for designing computer ontology of the subject discipline: software architecture and tools development; interoperability; intuitive interface are established. The selection of techniques for designing ontologies using computer ontology systems is carried out. The algorithm of designing computer ontology of the subject discipline by the future teachers-engineers in the field of computer technologies is proposed.

Keywords: computer ontology, knowledge representation, subject field, educational discipline, model, teacher-engineer, designing.

1 Introduction

1.1 Setting of a problem

One of the important trends in the development of modern computer systems is ontologically managed information systems. The construction of the latter is closely connected with the development of theoretical foundations and design methodologies including a formalized approach, fundamental principles and mechanisms, generalized architecture and structure of the system, a formal model and methodology for designing ontology of the subject field (including ontologies of educational disciplines), formal model of presentation of knowledge, generalized algorithms of procedures for knowledge processing, etc. Accordingly, each of the listed components of the overall design methodology is a complex information and algorithmic structure and is part of the field of future teachers-engineers in the field of computer technologies (CT). Comprehensive solution of these tasks of design will provide an opportunity to enhance the role of ontological (conceptual) knowledge in solving concrete problems in applied branches in general and in the educational process in particular [4, p. 9].

Investigations on the study and use of computer ontologies by the future teachers-engineers in the field of CT cover both cognitive knowledge of knowledge bases and their means of engineering, and the structure of information (a list of its types and relationships), necessary for obtaining solutions, means of obtaining and preparing this information, the procedures for setting tasks for the design of computer ontologies, solving these problems and obtaining results.

However, the process of designing computer ontologies is complex and lengthy and requires knowledge of many declarative languages, and in order to facilitate it, there is a need for the use of certain systems created to design computer ontologies that provide such interfaces that allow them to conceptualize, implement, verify inconsistency and documentation. In recent years the number of tools for working with computer ontologies has increased dramatically (more than 50 editing tools). However, most of these tools are intended to use existing ontologies by the help of formal languages, such as: Common logic; Cyc; Gellish; IDEF5; KIF; Rule Interchange Format (RIF) and F-Logic; OWL; XBRL [20]. Therefore, in the process of training future teachers-engineers, it became necessary to use these systems for designing computer ontologies that could provide interfaces that would allow operations to be carried out in connection with the formal representation of sets of concepts and relationships between them. Computer system ontology (CSO) is a definite answer to this need specifically in the context of designing computer ontology of the discipline subject field by future engineers-teachers in the field of CT.

1.2 Analysis of recent research and publications

The process of developing and using ontology in general form is considered in the works of Sergei Nirenburg [17], Natalya Fridman Noy [18], Victor V. Raskin [23]. Problems of ontologies and their use in computer systems were considered by Vladimir A. Lapshin [9]. The discovery of the meaning of the concept of "ontology", given to it in the computer sciences, the works of James F. Allen [19], Richard Fikes [15], Thomas R. Gruber [6], and others are devoted to it. Some aspects of the use of computer ontologies, in the context of intellectual technologies, are discussed in the works of Vasyl V. Lytvyn [13], Oksana M. Markova [14], Volodymyr V. Pasichnyk [11], Serhiy O. Semerikov [24], Oleh M. Spirin [26], Illia O. Teplytskyi [25], Ivan M. Tsidylo [31], Yurii V. Yatsyshyn [12] and others. An overview of the instruments of ontology engineering was done by Olha M. Ovdii and Galyna Yu. Proskudina [20]. Methods for creating an interface based on ontology in the environment of the WEB portal were studied by Kostiantyn V. Liashuk [27], Maryna A. Popova [22], Oleksandr Ye.

Stryzhak [28]. The modeling of the ontology of the educational subject field as a means of integrating knowledge was studied by Vira V. Liubchenko [10], Oleksandr Ye. Stryzhak [28], Ivan M. Tsidylo [30], Olena H. Yevseieva [32] and others. Modeling the categorical level of the language-ontological picture of the world was studied by Oleksandr V. Palagin and Mykola H. Petrenko [21]. Ontological representation of decision-making processes was done by Yurii P. Chaplinskyi [3]. Using the ontology of the subject area to eliminate ambiguities in the computer translation of technical texts was applied by Alla V. Morentsova [16] and others. The works of the above-mentioned authors contributed to the accumulation and systematization of knowledge for improving the practical training of students on the creation and use of computer ontology. However, they do not sufficiently revealed the peculiarities of the creation of the ontology of a certain subject field in the professional training of future teachers-engineers of the computer field, taking into account the professional-engineering and professional-pedagogical activities of future specialists.

1.3 Purpose

The purpose of the article is to justify the methodology of designing the ontology of the subject field of the discipline as a means and result of systematization of knowledge in the process of preparation and practical work of the future teachers-engineers in the field of computer technologies.

2 Results of the study

In the process of training teachers-engineers in the field of CT in the higher educational institutions, a significant place is the study of intelligent systems, in which ontologies are used for the formal specification of concepts and relationships that are inherent in a certain field of knowledge. Since the computer cannot understand how a person does, the state of things in the world, it must be submitted with all the information in a formal way. Consequently, ontologies serve as a kind of model of the surrounding world, and their structure is such that it is easily subjected to machining and analysis. Ontologies provide the system with information about well-described semantics of given words and indicate the hierarchical structure of the medium and the relationship of the elements. All of this allows computer programs to draw conclusions from available information and manipulate those using ontologies.

The term “ontology” first appeared in the work of Thomas R. Gruber [3], who considered various aspects of the interaction of intellectual systems directly between themselves and with man. Intelligent systems are called programs that simulate some aspects of human intellectual activity. Certainly, any program to some extent deals with this simulation, because this is the value of a computer for a person: the computer system allows you to free it from performing some rather complex and sophisticated, but always the same type of activity: the computer system created, for example, for editing graphics, cannot be used to manage complex production machines.

The task of constructing a description of knowledge is very specific. Therefore, Gruber has identified a specific term for this task – the explicit specification of conceptualization. A conceptualization is an abstract, simplified view of the world that we wish to represent for some purpose. Every knowledge base, knowledge-based system, or knowledge-level agent is committed to some conceptualization, explicitly or implicitly. The peculiarity of the task of conceptualization lies in the fact that for the exchange of knowledge between software systems (in the context of the concept of artificial intelligence), it is necessary to openly specify their conceptualization, that is to build a description of this knowledge, moreover, sufficiently formal, that it was "understood" by other systems.

In the process of developing intelligent systems, the most time-consuming are the stages of conceptualization and formalization, which are considered in work [2] in the process of designing a structural model of a neuro-fuzzy expert decision-making system for determining the professional selection of students for the training of IT specialties.

Consequently, the concept of "engineering ontology" can be defined as a specification (a formal description) of a certain conceptualization (representation of the subject field of the investigated task as necessary for a particular task). If the specification of the interpretation is rather unambiguous, then conceptualization is not all so simple. Thomas R. Gruber believed that conceptualization was carried out in terms of classes and attributes [7, p. 911]. The medium of the study problem is presented in the form of concepts that are described by classes, along with their properties (attributes) and specific objects – instances of classes.

More specifically, the concept of ontology is defined by David Faure, Claire Nédellec and Céline Rouveirol [5], who assumes that ontology is an explicit specification of a particular topic.

This approach involves the formal and declarative representation of some of them covering the dictionary (or list of constants) for reference to the terms of the subject industry, limiting integrity to terms, logical statements that limit the interpretation of terms and how they relate with each other.

Thus, ontology defines a general terminology for scholars who need to share information in a particular subject area. It covers computer-aided interpretations of the basic concepts of the subject industry and the interrelationship between them.

Thus, ontology defines a general terminology for scholars who need to share information in a particular subject area. It covers suitable for interpretation by means of a computer definition of the main concepts of the subject field and the interconnection between them. With the increasing popularity of usage of computer ontologies, their study should be included in the curricula of the higher educational institutions, since they can generate test tasks, create didactic materials from different disciplines and branches of knowledge, etc.

However, as noted above, the process of designing computer ontologies is complex and lengthy and requires knowledge of many declarative languages. Therefore, in the activities of future CT teachers-engineers it is more appropriate to use CSO that are a computer program or software package that intended for the construction of computer ontology from a certain subject field and perform operations related to the formal representation of sets of concepts and relationships between them, in addition, computer ontologies can be exported to a variety of formats, including invoking RDF (RDF Schema), OWL and XML Schema, etc.

Regarding the choice of a specific CSO, it should be implemented according to some of the following criteria [8]:

- software architecture and development of tools containing information about the necessary platforms for using the tool;
- functional compatibility, which includes information on tools and interaction with other languages and tools for the development of ontologies, translation from some languages ontologies;
- the intuition of the interface, covering the work with graphic editors, the co-operation of several users and the need to provide multiple use of ontology libraries.

However, for the construction of computer ontology of the subject field of the discipline, future teachers-engineers need to reflect the content of the subject field of the discipline, which is described in the form of a list of modules, implemented in various forms of occupations in a particular discipline. While in addition to the content, form and control of their volume, the corresponding competence for each module are indicated. Based on the analysis of the subjects and objects of the learning process, the processes of creating and managing the educational material, one can identify the following problems that arise during the development of the training course:

- high complexity of the process of finding new teaching materials;
- the need to assess the conformity of educational resources with the requirements of the content of the training course;
- providing educational resources with the full coverage of the modules of the discipline in general and the course in particular;
- excessive coverage of the modules of the discipline and implementation of the choice of the most optimal educational resource for a particular situation;
- the need to assess the quality of educational resources.

Thus, in the process of developing the content modules of the discipline, it is important that on the basis of the system analysis of the specifics of the subject field, the following requirements for the model of presentation of knowledge and data, which was offered by Anton V. Anikin [1, p. 62].

1. The model should describe the subject discipline, the structure of the subject field, the hyponymic relationship between the concepts of the subject industry (hierarchical relations), the relation of the meronymic (part-whole), the connection of related terms (which may, in particular, reflect antagonistic relationships, active-passive relationships, cause-effect relationships, position or paradigmatic relationships).
2. The model should describe the synonymy of the terms of the subject field of the discipline, as well as their presentation in various languages.
3. The model should describe: competences of different levels, obtained because of mastering the discipline; the knowledge, skills and abilities they carry out; hierarchical relations between these elements.

4. The model should describe the electronic educational resources, regardless of their presentation, place of storage, didactic role and allow the creation of a repository of such resources based on their descriptions. In this case, the description of the educational material should include the specified parameters, as well as the language of presentation of information, the educational goal in the form of the received competencies, determined through knowledge, skills, and complexity of educational resources.
5. The model should describe the student's profile: the choice of language, the current field of knowledge of the studied discipline taking into account the level of his knowledge of the various structural elements of discipline, the level of mastering of individual competencies within the framework of the discipline as well as the learning objectives described on the basis of the target competences of the discipline.
6. The model should describe the personalized educational collection as a plurality of learning resources, which is a subset of the discipline and is included in the repository, selected based on the student profile, as well as the set of relations between them, which specify the recommended order of their study.
7. The model should ensure the harmonization and integration of the description of the teaching resources, the subject discipline, the student profile and personalized e-learning material through the use of general concepts of the subject industry for the identification and reuse of: competencies (current and target), data through knowledge (presented in the form of terms – concepts of the subject field), skills and assumptions; language (representation and perception of information); the complexity of teaching material and the level of knowledge of these competencies.
8. The model should provide the possibility to search educational material according to its parameters, the possibility of building a personalized electronic educational collection based on the profile of the student and the repository of the subject field.
9. The model should support accumulation, distribution (joint use) and reuse of knowledge about the subject field of educational disciplines in electronic educational resources.
10. The model should provide modularity and extensibility.

To implement a model of presentation of knowledge and data that meet the requirements considered, it is expedient to use an ontological model of presentation of knowledge, which combines the properties and advantages of other models of presentation of knowledge and data (graph model, tree-based model, relational model, semantic network, framing, logical model, etc.).

Solving the tasks of the search and integration of educational material in the personalized educational collection can be realized in the ontological model because of the development and inclusion of the corresponding semantic rules in computer ontology.

The formal model of ontology can be represented as:

$$O = \langle C, R, F \rangle,$$

where C – the final set of concepts of the subject field, which determines the ontology of O; R – the final set of relations between them; F is the final set of functions of interpretation given on the concepts and / or ontology relations of O.

The restrictions imposed on the set C are not infinity and are not empty ($C \neq \emptyset$). The sets R and F can be empty, which corresponds to certain types of ontology, when it degenerates into a simple dictionary ($R = \emptyset$, $F = \emptyset$), taxonomy of concepts ($F = \emptyset$), etc.

One of the possible ontological bases for describing computer ontologies in the context of the use of CSO by future engineer teachers, presented in the work of Iurii A. Zagorulko and Olesia I. Borovikova [33, p. 197], are:

- classes united in taxonomy;
- relationship (type of links between concepts of the subject industry);
- functions (a special kind of relationship in which the *n*-th element of the relationship is determined by the values of *n*–1 of the preceding elements);
- axioms (simulate offers that are always true);
- specimens (entities) that make up specific objects of the real or abstract world.

Iurii A. Zagorulko and Olesia I. Borovikova [33, p. 199] chose OWL-DL, the language for the description of ontology, recommended by the consortium W3C, which is widely used in Semantic Web, is able to be converted by the overwhelming majority of CSO and allows to use:

- the logic of the first order for assigning axioms to ontology concepts through the design of constructs of descriptive logic;
- existing ontology output machines on OWL-DL, allowing for arguments based on the rules of descriptive logic;
- existing free tools for designing ontologies in the OWL-DL language.

OWL-DL combines OWL expressiveness and completeness of computations (all logical conclusions performed on an ontology basis will be thoroughly calculated) and extensibility (all calculations are completed at a certain time). The OWL-DL contains all OWL language constructs that are subject to certain restrictions (for example, a class may be a subclass of many classes, but cannot be a representative of another class).

Accordingly, the ontological model of the subject discipline of the discipline ODD (Fig. 1) will be defined as:

$$O_{DD} = \langle C_{DD}, Inst_{DD}, R_{DD}, I_{DD} \rangle,$$

where C_{DD} is the final set of concepts for the ontology of the core curriculum knowledge ($C_{DD} = \{c_{DD1}, c_{DD2}, c_{DD3}, c_{DD4}, c_{DD5}, c_{DD6}, c_{DD7}, c_{DD8}, c_{DD9}, c_{DD10}, c_{DD11}, c_{DD12}\}$, c_{DD1} is the DataDomain class for the definition of the subject discipline; c_{DD2} is the Competence class for identifying competences in a learning discipline; c_{DD3} is a Concept class for defining the concepts (terms) of a discipline subject field that is a subclass of c_{DD2}; c_{DD4} is a UCompetence class for identifying universal competencies; c_{DD5} is a class of PCompetence for defining professional competencies; c_{DD6} is a ZNKCompetence class for general knowledge competencies; c_{DD7} is a ICompetence class tool for determining competence; c_{DD8} is a SOKCompetence class for the definition of social / personal / general cultural competencies; c_{DD9} is the Skill class for determining the skills obtained in the subject discipline, which is a subclass of c_{DD2}; c_{DD10} is the Ability class for determining the skills obtained in the subject field of the discipline, which is a subclass of c_{DD2}; c_{DD11} is a Language class that defines the language of presentation of information in the discipline subject field; c_{DD12} is a Complexity class to determine the level of development of competencies of the discipline);

$Inst_{DD}$ is the set of competencies, concepts of the subject discipline, as well as the skills represented in the natural language of instances of classes C_{DD}; $Inst_{DD} = \{i_{DD1}, i_{DD2}, ... i_{DDm}, ... i_{DDn}\}$;

R_{DD} is the final set of relations of the ontology of the knowledge base of the discipline; ($R_{DD} = \{r_{DD1}, r_{DD2}, r_{DD3}, r_{DD4}, r_{DD5}, r_{DD6}, r_{DD7}, r_{DD8}, r_{DD9}\}$; r_{DD1} is a hasLanguage ratio, r_{DD2} is a hasComplexity ratio, r_{DD3} is a ratio includes, r_{DD4} is a hasHierarchicalRelation ratio, r_{DD5} is a dependOn ratio, r_{DD6} is a ratio isSynonym, r_{DD7} is a ratio "is", r_{DD8} is a hasTitle, r_{DD9} is a hasCompetence);

I_{DD} is the set of interpretation rules, $I_{DD} = \emptyset$.

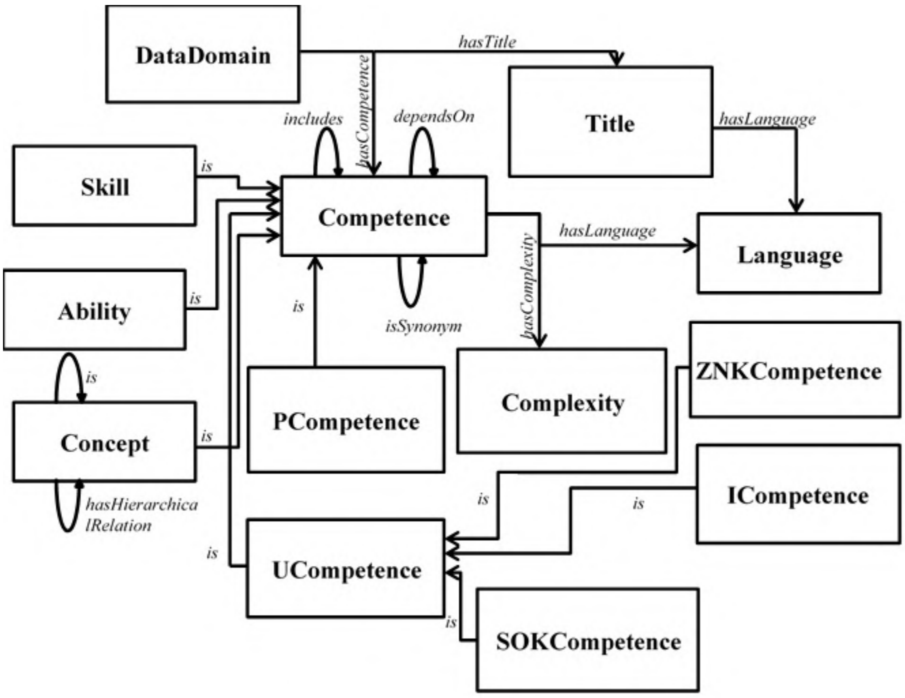

Fig. 1. Scheme of ontology of the subject field of discipline

The set of concepts for the C_{DD} ontology of the knowledge base of the discipline is presented in Table 1, and the set of R_{DD} relationships is in Table 2. The defining areas and the domains of relationship values can be both defined concepts and their daughter concepts within the framework of the ontology. Based on the plurality of these concepts and the relationship between them using the CSO, future teachers-engineers will be able to conduct ontological design of the subject field of the discipline they need.

Table 1. The set of concepts of ontology of the subject discipline

Ontology concept	Parental concept	Concept description
DataDomain	Thing	Subject field of discipline
Competence	Thing	Competences
Concept	Competence	Concepts (terms) of the subject discipline
UCompetence	Competence	Universal competences of the subject discipline
PCompetence	Competence	Professional competence of the subject field of the discipline
ZNKCompetence	UCompetence	General scientific competence of the subject field of the discipline
ICompetence	UCompetence	Instrumental competences of the subject discipline
SOKCompetence	UCompetence	Socio-personal / general cultural competences of the subject discipline
Skill	Competence	Skills in the subject field of the discipline
Ability	Competence	Ability of the subject field of the discipline
Language	Thing	Language of presentation of information
Complexity	Thing	Level of mastery of the competence of the subject discipline

Table 2. The set of relations of the ontology of the subject discipline

Correlation	Definition area	Value range	Description
hasLanguage	Competence	Language	The ratio that sets the language of the presentation of the ontology
hasComplexity	Competence	Complexity	The ratio that sets the level of competence development
includes	Competence	Competence	The relation of inclusion of competences in the competence of a higher level, concepts, skills and abilities – in competence (through the mechanism of imitation)
dependsOn	Competence	Competence	Relationship between the two competencies, concepts, skills or abilities
isSynonym	Competence	Competence	The relation of synonymy to the concepts of the subject field and competencies
is	Concept	Concept	The relationship "is" between the concepts of the subject field
hasHierarchicalRelation	Concept	Concept	The ratio of the hierarchy between the concepts
hasTitle	Competence DataDomain	String	The ratio that sets out the description of competence, concept, skills, ability in form of text
hasCompetence	DataDomain	Competence	The ratio that sets the relationship of competence with the subject field

However, the question about the methodology of designing computer ontology remains unsolved. Now there are several methods of constructing ontologies and they all are based on the principles proposed by Thomas R. Gruber [7]:

- *Clarity*. Ontology must effectively convey the meaning of the terms. Definitions should be objective, although the motives for introducing terms may be determined by the situation or the requirements of computing efficiency. To objectivize definitions, a clearly defined formalism must be used, in which logical definitions should be defined as logical axioms.
- *Coherence*. The ontology must be compatible, that is, the conclusions that can be drawn from the definitions of concepts and relationships between them must be compatible with the initial terms. Compatibility should also be maintained for the concepts informally described. If the conclusions drawn from the formal meanings are incompatible with the informal descriptions, then the ontology is considered incompatible.
- *Extendibility*. The ontology must be constructed so that it can be used without additional effort in separate ontology libraries. One of the most important conditions for such a design is the ability to identify new concepts based on the elements existing in the ontology so that this does not require the change of the latter.
- *Minimal encoding bias*. The projected conceptual scheme should not depend on the specific language used to record the formal description. Dependence on coding occurs when the choice of an ontological representation is based on compatibility with the peculiarity of the language in which the ontology is written. This dependence must be minimized so that various ontology databases using other languages can easily understand the projected ontology.
- *Minimal ontological commitment*. The ontology must contain at least the facts about the ontology of the world, which is modeled, while giving the freedom to use this ontology in others. If the conceptual scheme of the problem is that the description of the ontology of the world is essential, then this description should, if possible, be minimal. One should restrict itself to merely recounting the terms of the concepts without determining the relation between them that is to build a “weak” theory. Then different bases of ontologies, which determine the ontologies of the world in their own way, can give meaning to this concept.

However, in the context of designing computer ontology of the subject field of discipline by means of Protege, it is most appropriate to use the technique of constructing an ontology proposed by Vasyl V. Lytvyn, Volodymyr V. Pasichnyk and Yurii V. Yatsyshyn, which includes seven steps [12, p. 319].

Step 1. Define the industry and the scale of the ontology. Work on the development of ontology should begin with determining its scope. To this end, competence issues are being developed to verify the relevance of the ontology of a given subject field, which will continue to serve as a litmus test, giving an idea of the completeness of the information provided and the level of its detail.

Step 2. The ability to use existing ontologies. It is worth bearing in mind that somebody worked on the task of creating an ontology, for example, in the field of material science. Then you need to check the possibility of adapting the existing ontological systems for our specific subject area. Otherwise, work must start from scratch. Today, many developed ontologies in various subject areas are available and can be successfully imported into the design environment chosen by the developer.

Step 3. List of important terms in ontology. It is useful to compile a list of all the terms and their properties, which provide the basic information about the given subject area. At the beginning, it’s important to get a complete list of terms without worrying about whether the concept is a class or property.

Step 4. Define classes and their hierarchy. There are several approaches to constructing a hierarchy of classes: top-down, bottom-up, and combined process.

Step 5. Define the properties of the classes. After determining a certain number of classes, it is necessary to describe the internal structure of concepts. In step 3, the classes in the list of terms created were selected. Most of the remaining terms are likely to be the properties of these classes. All subclasses of the class inherit the property of this class.

Step 6. Determination of facets properties. Properties may have different facets that describe the type and factor (power) of the property value, range, and other characteristics that it may have.

Step 7. Creating instances. The last step is to create separate instances of classes in the hierarchy. To determine an individual instance you need:

- choose a class;
- create a separate instance of this class;
- enter slot values.

Therefore, for the design of computer ontology of the subject field of educational discipline for future engineers-teachers in the field of computer technologies, it is expedient to carry out the following algorithm:

- Select on the basis of the scheme proposed in Fig. 1, competencies of the first level – universal (general, instrumental, social-personal competencies of subject discipline) and professional – on the basis of analysis of the work program of discipline and matrix of competencies. Describe them as instances of the corresponding classes of computer ontology of the study discipline (UCompetence, PCompetence, ZNKCompetence, ICompetence, SOKCompetence).
- Sequentially allocate competences of the second level by analyzing the list of acquired knowledge, skills and abilities. Describe them as instances of the corresponding classes of computer ontology of the discipline (Concept, Skill, Ability).
- Based on the analysis of the work program of the discipline and the matrix of competencies, allocate the third level competencies that are implemented within each module of the curriculum and describe them as instances of the corresponding classrooms of the computer ontology (Concept, Skill, Ability).
- Based on the knowledge of the future teacher-engineer in the field of CT on the subject discipline and the availability of educational-methodical literature, identify the competences of lower levels and describe them as instances of the corresponding classes of computer ontology of the discipline (Concept, Skill, Ability). The

recommended number of levels of competence in describing the set of knowledge discipline is 3 or 4. Additional levels can be used in the description of knowledge in the form of concepts of the subject area in the case of availability in the individual modules of discipline a large number of terms of the subject field, which are related hierarchically. For the description of skills and abilities, in most cases it is up to 3-4 levels of competencies.
- On the basis of the curriculum work program, as well as knowledge of the subject area and the analysis of educational methodical literature, identify the relationship between the competencies described and set them with the following relationships of the ontology of the discipline: includes (the ratio of the inclusion of competencies in a higher level of competence), dependsOn (dependency ratio between two competencies, concepts, skills or abilities). If there is synonymy, set the appropriate relation to isSynonym. In describing the discipline subject field, use the hasTitle and hasLanguage relationship to describe the description of the respective competences in the natural language and language of the description.

3 Conclusions and perspectives of further research

1. The scheme of the ontology of the subject discipline is presented based on which the future teachers-engineers in the field of CT are. In it, the set of concepts of the future computer ontology of the subject discipline is represented; and the set of relations between them, and corresponding definition areas and range of values can be as these concepts, as well as their daughter concepts in the framework of ontology. Based on the set of these concepts and the relationships between them using the CSO, future teachers-engineers will be able to conduct ontological design of the subject field of the discipline they need.
2. The main criteria for choosing a CSO are: 1) software architecture and tools development contain information on the required platforms for using the tool; 2) functional compatibility contains information on tools and interaction with other languages and tools for the development of ontologies, translation from some languages ontologies; 3) intuitive interface – covers work with graphic editors, collaborative work of several users and the need to provide multiple uses of ontology libraries.
3. In the process of selecting a method for designing computer ontologies by means of CSO, the optimal option in the educational process of the future teacher-engineer is the method proposed by Vasyl V. Lytvyn, Volodymyr V. Pasichnyk and Yurii V. Yatsyshyn [12], which provides a number of stages of designing a computer ontologies.
4. The methodology of designing computer ontology of the subject discipline for the future teachers-engineers in the field of CT is offere, which includes the scheme of ontology of the subject discipline, the choice of CSO with the help of which the project is being implemented. The methodology of designing computer ontology and the algorithm for computer ontology designing of the subject discipline for future teachers-engineers in the field of CT is proposed.

5. The continuation of scientific research on the given problem is useful in the study of the dependence of constructed hierarchy concepts in the computer ontology of the subject discipline and the development of ontologically managed information systems on their basis.

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