International Journal of Science and Technology Volume 1 No. 1, January, 2012

Use of Ontological Analysis for Student Skills Control in E-Learning: Semantic Web Approach

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ABSTRACT

The important elements of effective learning are control of student skills and ability for retrieval of new information relevant to subject domain of learning. We propose to use the domain ontology as an instrument for student skills examining. Students have to build the personal domain ontologies and thesauri of examine discipline (on base of natural language texts relevant to subject domain – lectures, textbooks, manuals etc.) and then compare them with reference ones that are built by tutor. Analysis of student mistakes allows to propose them personalized recommendations and to improve the course materials in general. Personal ontologies are improved in process of learning and can expand the reference ontology according to personal skills and knowledge of student (fir example, by terms in other languages known to student). In future this ontology can be used for personificated informational retrieval in corresponding subject domain.

Key words: *ontology, intelligent agent, Semantic Web*

1. INTRODUCTION

The growth of the information society provides a way for fast data access and information exchange all over the world. Now, a lot of materials that used for education process exist in electronic form. In many domains the results of work are plain test materials. However, human readable data resources (like student control works, reports etc.) have serious problems for achieving machine analyses.

Computer technologies have been significantly changing the content and practice of education. The consequent applications of multimedia, simulation, computer-mediated communication and communities, and internet-based support for individual and distance learning all have the potential for revolutionary improvements in education [1, 2].

Online learning (e-learning) offers new possibilities in learning: a student can et immediate feedback on solutions to problems, learning paths can be individualized, etc. Online learning is a growing business: the number of organizations working on online learning and the number of courses available on the Internet is growing rapidly. Now a lot of e-learning tools with varying functionality and purpose exist [3, 4].

E-learning is an alternative concept to the traditional tutoring system. The course tutor in a software tutoring system controls learners relatively weaker than in the traditional one where it is the tutor who is charge the contents and sequence of instructions. Therefore, in order to obtain better tutoring outcomes, a software tutoring system should emphasize engaging students in the learning process and be adaptive to each individual learner.

The goal of the early software tutoring systems was to build user interfaces that provide the efficient access to knowledge for the individual learners. Recent and emerging work focuses on the learner control over the learning process such as learner exploring, designing, constructing, and using adaptive systems as tools [5].

With the application of more computer techniques in education and the involvement of more adults in software tutoring systems, the learner control strategy has become more appreciated than tutor control or program control.

Learning control needs the comparison means of learner's knowledge base that forms (and modifies) in learning process with the course domain knowledge base. It requires the powerful and interoperable tools of knowledge representation and analysis.

A structured information representing is required and ontologies (machine processable representations containing the semantic information of a domain) can be very useful. The ontology systems serve as a flexible and extendable platform for knowledge management. The inspiring idea to develop reusable atomic learning components and to capture their characteristics in widely-accepted, formal metadata descriptions will most probably attract learning object providers to annotate their products with the accepted standards.

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The experience of the developed countries shows the technological achievement of remote training — e-learning - that opens many new opportunities in expansion of student's number with the same number of the tutors and in improving of education quality. In recent years, e-learning has been widespread, especially since standardizing initiatives for learning technologies [6] have begun.

For distant learning where the tutor works with many students without direct contacts, it is very important to provide the objectivity and automatization of knowledge examination.

An important component of e-learning is testing of student's skills and knowledge. One of the main problems arising during creation of testing systems is an interoperability of created tests – opportunity to reuse these tests in different testing systems. To organize test exchange between various systems it is necessary to create some universal format of tests preservation and their processing instructions. And an important condition for this format should be its independence from the platform. Standardization of educational technologies and, in particular formats of test data preservation are working out all over the world. Now Ministry of Education and Science of Ukraine realize the Program of On-line Education Development. According to these activities the development of projects of standards for systems, methods and technologies standards of on-line education in educational institutions taking into account international standards was provided. But different test formats such as Instructional Management Systems (IMS) Question and Test Interoperability (QTI) of Global Learning Consortium are not adequate to reflect all relationships of different applied domains.

But the more serious problems are caused by the test semantic. Many authors [7,8] utilize the ontology's semantic data to improve the analyses of information in unstructured documents. The domain ontology plays central role as a resource structuring the learning content [9]. One of the key challenges of the course construction process is to identify the abstract domain of information within which this course will exist. Tutor has to describe the main terms and concepts from which a course is to be constructed.

The main idea of our approach is that the *domain ontology* is not only the instrument of learning but an object of examining and forms by students. We propose for students to build the domain ontology of examine discipline and then compare it with reference one. Results of this comparison show the mistakenly understood parts of domain knowledge and help tutor in improvement of distant course. Realized experiments demonstrate that this approach is much more efficient then usual tests where some mistakes can be involved by ambiguous formulation of questions and misprints, but correct answers can be obtained intuitively or by accident and don't reflect the real student concept about domain.

2. KNOWLEDGE REPRESENTATION AND KNOWLEDGE MANAGEMENT

Knowledge management is a big challenge especially in large organizations such as the big modern universities that provide traditional and distant forms of learning. Knowledge exists there in different forms: as explicit knowledge in documents and processes and as tacit knowledge in people and procedures and in many different forms between these two extremes.

They are knowledge as personalised information, state of mind, object, process, access to information and capability. And there are even other definitions, such as knowledge as an asset. The best ways to manage knowledge depends naturally on which view on knowledge is taken, and then to choose the methods accordingly. There are many ways to view on the knowledge management process [2], the following five steps are often identified: 1. Acquisition, 2. creation, 3. storage, 4. validation, and 5. utilisation.

3. SEMANTIC WEB AS ENVIRONMENT OF KNOWLEDGE

The current Web can be classified as the second generation Web. The first generation started with the "handwritten" HTML web pages. The second generation, made a step forward introducing machine - generated web pages or even active HTML pages. The common characteristic between the first two web generations is that they are both human - oriented. The third generation of the Web is what is widely known as the "SemanticWeb" and its main difference from the previous two generations is that it aims to machine - readable information ([1]).

The current Web can be classified as the second generation Web. The first generation started with the static and easy HTML pages. The second generation widely uses active HTML pages and complex Web sites with databases. The common characteristic of the both first two web generations is that they are human-oriented. The Semantic Web is the new generation of the World Wide Web, based on the semantic network knowledge representation formalism, which enables packaging information in the form of object-attribute-value statements, so called triplets. The main difference from the previous two generations the third generation of the Web is that it aims to machine - readable information.

The vision of the Semantic Web proposes more intelligent services by facilitating machine understanding of content. Ontologies are an important building block of knowledge in the Semantic Web. Ontologies provide a shared and common understanding of a domain that can be communicated across people and applications.

An important advantage of the Semantic Web is that people can collaboratively create ontologies and build common vocabulary without centralized control. One building block of Semantic Web ontologies is a Semantic

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Web Term (SWT) which plays the role of a word in natural languages. The set of SWT is a bridge between the RDF statements with formal semantics defined in RDF(S) and OWL. SWt are intended to be reused as universal symbols. A Semantic Web term is an RDF resource that represents an instance of rdfs:Class (or rdf:Property) and can be universally referenced by its URI reference (URIref).

Ontology as a branch of philosophy deals with the theory of. In information technology, ontology is the working model of entities and interactions in some particular domain of knowledge or practices. In IT an ontology is the specification of conceptualizations, used to help programs and humans share knowledge. In this meaning, an ontology consists of specified concepts that are defined to create an agreed-upon vocabulary for information exchange. Knowledge in ontologies is mainly formalised using five kinds of components: classes, relations, functions, axioms and instances. [3]

By assuming that terms used in these statements are based on the formally specified meaning (for the community of interest), i.e ontologies, and these triplets can be semantically processed by machine agents. Most of the current Semantic Web applications are based on using such atomic statements as pure facts.

4. OVERVIEW OF E-LEARNING SYSTEM BASED ON SEMANTIC WEB

The advent of Semantic Web and its relevant technologies, tools and applications provide a new context for exploitation. The 'expression of meaning' relates directly to numerous open issues in e-learning. In this special issue the focus is twofold: on the one hand to stress the importance of Semantic Web towards systems that provide value to learners, and on the other hand to reveal research opportunities that can initiate interesting research and projects in the forthcoming years.

The exploitation of Semantic Web in the context of e-learning requires a deeper understanding of the relevant issues. In Figure 1, we have summarised some key research themes related to the convergence of Semantic Web and e-learning. More specifically, we have used a matching of key issues that play a significant role in Semantic Web and e-learning research, and we have presented a set of research priorities. Three circular areas summarise the current research in semantic e-learning. For their discussion, we have used the following pairs, where the first part relates to the Semantic Web key issue and the second one to the e-learning key issue:

1. Expression of meaning–Content authoring. The direct relation of Semantic Web and e-learning combines the traditional content authoring process with the critical objective of expression of meaning. Issues like semantic mark-up, semantic retrieval, personalised (semi-) structured annotation and content conversion are prominent parts of a big research stream, in which the main concern is the development of semantic e-learning content.
2. Ontological evolution–Adaptive hypermedia. The traditional adaptive hypermedia considerations in e-learning have been combined with ontological engineering, and a lot of flexible systems and accompanied methodologies have emerged. Issues like ontology construction, ontology integration, conceptual modelling and semantic conceptualisation reveal a new research agenda, in which the specifications of conceptualisations (ontologies) promote the performance of learning systems.
3. Information flow and collaborative life–Learning context. The instrumentation of knowledge flows has been included in the priorities of the W3C Semantic Web activity. According to Eric Miller, 'one of the challenges we will meet is to strike a balance between on the one hand requiring authors to do more at the outset in order to make information machine processable, insisting that everything the machine could use to answer a question be recognized and identified by the (human) questioner, and, on the other hand, to leave large quantities of information inaccessible to the machine'. Within this area, semantic services, (semi-) automated reasoning and argumentation are critical themes on the semantic elearning agenda.
4. Policy-aware infrastructure–Interoperability/ Standards. The e-learning industry has demonstrated many achievements within the area of interoperability and standards, and from this perspective this industry recognises the need to secure a policy-aware infrastructure. The Semantic Web will only achieve its potential as an information space for the free flow of scientific and cultural information if its infrastructure supports a full range of fine-grained policy controls over the information it contains. The issues of different types of control over content, the compliance to semantic and metadata models, as well as the versioning and provenance of content, require extensive research.
5. Web of trust–Communities/Social dimensions. According to Eric Miller (2004): Trust in the human social context is based on constantly evolving and adapting information. Two parties may trust each other based on (1) a history of mutual interaction, (2) formal contracts that rely on other established systems (e.g. legal and legislative), and (3) risk analysis of a failure of any party to perform as agreed. In the e-learning industry this issue is of critical importance. The marketplaces of learning objects, the unique identification of resources and the development of intelligent assistants will require a Semantic Web

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language for describing trust. Within this area a lot of work has to be done over the next few years.

In the forthcoming years, Semantic Web will provide an interesting research context for the e-learning research community. The inevitable role of knowledge and learning in the knowledge society will be the driver of several Semantic Web-enabled services, knowledge tools and applications for tutors and students.
E-Learning aims at replacing old-fashioned time/place/content predetermined learning with a just-in-time/artwork- place/customised/on-demand process of learning. It is based on management, culture and IT.
Semantic Web can be used as a very suitable platform for implementing an e-Learning system, because it provides all means for (e-Learning): ontology development, ontology-based annotation of learning materials, their composition in learning courses and proactive delivery of the learning materials through e-Learning portals. Personal ontologies can in future be used for group formation: gather students with similar thesauri and ontologies.

5. ONTOLOGICAL ANALYSIS

5.1 Basic Principles of Ontological Analysis

Ontological analysis is accomplished by examining the vocabulary that is used to discuss the characteristic objects and processes that compose the domain, developing rigorous definitions of the basic terms in that vocabulary, and characterizing the logical connections among those terms. The product of this analysis, *an ontology*, is a domain vocabulary complete with a set of precise definitions, or axioms, that constrain the meanings of the terms sufficiently to enable consistent interpretation of the data that use that vocabulary.
An ontology includes a catalog of terms used in a domain, the rules governing how those terms can be combined to make valid statements about situations in that domain, and the sanctioned inferences that can be made when such statements are used in that domain. In the context of ontology, a relation is a definite descriptor referring to an association in the real world; a term is a definite descriptor that refers to an object or situation-like thing in the real world. Formal model of ontology O is ordered triple of finite sets O = < T, R, F > [15], where T - the domain terms of which is described by ontology O; R - finite set of the relations between terms of domain; F – the domain interpretation functions on the terms and the relations of ontology O. In process of ontology building students use relations from the fixed set that contains the most widely used relations: R={"is a subclass of", "is a part of", "is a synonym", "has attributes", "has elements"}. It simplifies the ontology building and analyses processes.

5.2 Main steps of ontology construction

Building of ontology we base on IDEF5 methology.
By IDEF5 method, in ontology building students must perform three tasks:

1) Build the set of the domain terms;
2) capture the constraints that govern how those terms can be used to make descriptive statements about the domain;
3) build a model that, when provided with a specific descriptive statement, can generate the "appropriate" additional descriptive statements [11].

The students (as well as the tutor) have to execute four main steps to design the ontology of domain:

1. Define the main classes and terms of domain and describe their meaning:
   - Define the set of class names T;
   - Define the set of relation names R;
   - For every class name define the set of attribute names A_t;
   - For every attribute name $a \in A_t, t \in T$ define it type – INT, STRING, NUMBER ets. or other class of ontology;

1. Construct the taxonomy of domain terms:
   - Define all pairs of classes

$$<t_1,t_2>, t_1 \in T, t_2 \in T, r(t_1,t_2) -> t_1 "IS\_A\_Subclass\_Of" t_2, r \in R$$

;

2. Define synonymy and other relations between these terms:
   - Define all pairs of classes

$$<t_1,t_2>, t_1 \in T, t_2 \in T, r(t_1,t_2) -> t_1 "IS\_Synonyme\_Of" t_2, r \in R$$

   - Define all pairs of classes

$$<t_1,t_2>, t_1 \in T, t_2 \in T, r(t_1,t_2) -> t_1 "Related\_With" t_2, r \in R$$

3. Describe the instances of constructed classes:
   - Define names of instances a;
   - Define meanings of all attributes of instance class

$$\forall a \in t, t \in T.$$

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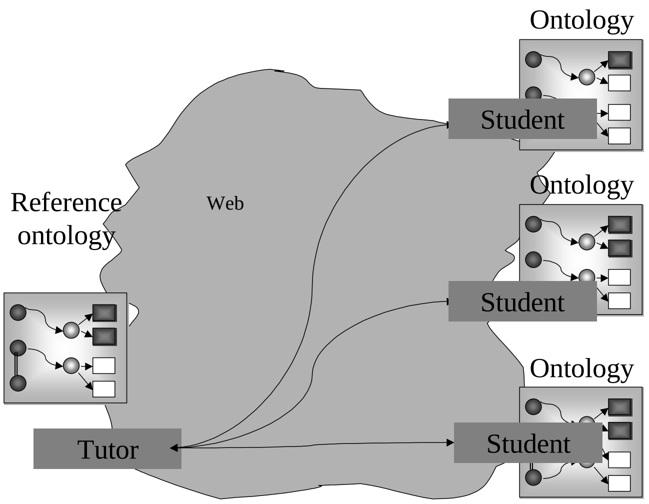

Fig.1: Ontology building process as a result of learning

5.3 Means of ontology construction

For knowledge interoperability we apply technologies developed in Semantic Web project [11].
The ontologies are stored in a semantic markup language OWL [12] that is developed as a vocabulary extension of RDF [13] for applications that process the content of information.
The OWL Web Ontology Language is being designed by the W3C Web Ontology Working Group as a revision of the DAML+OIL web ontology language.
The OWL syntax has a frame-like style, where a collection of information about a class or property is given in one large syntactic construct, instead of being divided into a number of atomic chunks for ease of readability. An OWL ontology is a sequence of axioms and facts, plus inclusion references to other ontologies, which are considered to be included in the ontology. OWL ontologies are web documents, and can be referenced by means of a URI. Ontologies also have a non-logical component that can be used to record authorship, and other non-logical information associated with a ontology.

```
<ontology> ::= Ontology ( [<authorship-etc>] {<directive>} )
<authorship-etc> ::= ...
<directive> ::= <imports>
<directive> ::= <axiom>
<directive> ::= <fact>
<imports> ::= imports ( <URI> )
```

Ontologies incorporate information about classes, properties, and individuals, each of which can have an ID which is URI reference. There are two built-in classes in OWL: owl:Thing is the class of all individuals, and owl:Nothing is the empty class. There are two kinds of facts in OWL. The first kind of fact states information about a particular individual, in the form of classes that the individual belongs to plus properties and values of that individual. An individual can be given an individualID that will denote that individual, and can be used to refer to that individual.
OWL is supported by many ontology visualizes and editors, like Protégé 2.0 [14]. Protégé is an integrated software tool used by system developers and domain experts to develop knowledge-based systems. Ontology in Protégé is a model of a particular field of knowledge - the concepts and their attributes, as well as the relationships between the concepts. It is represented as a set of classes with their associated slots.

5.4 Comparison of ontologies

The tutor compares domain ontologies built by students with reference ontology constructed by tutor.
Where two similar but different knowledge structures are going to be compared some types of differences can be appear:

- Structural;
- Label (synonyms and homonyms);
- Types of data;
- Levels of metasructure;
- Data types

We use the original algorithm for automatically comparing of ontologies that provides correspondence of hierarchical levels in term taxonomy (if class A is a subclass of B in reference taxonomy and B is a subclass of A in students taxonomy there is a mistake - Fig.2) and controls affiliation of instances with classes (if instance a belongs to class A in reference taxonomy and student describe instance a that belongs to class B is a mistake - Fig.3).
This algorithm is based on some specific conditions and that's why cant be used for matching of arbitrary ontologies:

- Student has to use ontological terms for classes and subclasses only from the fixed set corresponding to terms of reference ontology, other terms are considered as mistakes;
- Student has to use relations between classes only from the fixed set corresponding to relations of reference ontology, other relations are considered as mistakes too;
- If student nevertheless use some term that doesn’t exist in reference ontology this term has to correspond to some term of reference ontology (student can use the incorrect name by mistake)

6. ALGORITHM OF ONTOLOGY COMPARISON

We compare the student ontology O_s with reference ontology O_e made by tutor

1. Define the sets of ontology terms T_s and T_e .

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2. Classify terms from T_s on three disjoint categories:

   T_n, T_u and T_w. $T_s = T_n \cup T_u \cup T_w$ where
   - Correctly defined terms

     $$T_n \subseteq T_e \,,$$
   - Not accurately defined terms

     $$T_u \not\subset T_e \text{ but}$$

$$\forall t_i \in T_n \exists t_{j_1} \in T_e, ..., t_{j_m} \in T_e, t_{j_k} \in T_e, m = \overline{1,k} \text{, and}$$

   - Incorrectly defined terms

     $$T_u \not\subset T_e \text{ and } \forall t_i \notin T_n \neg \exists t_j \in T_e \,.$$

3. Define the sets of ontology relations R_s and R_e .
4. Classify relations from R_s on three disjoint categories:
   R_n, R_u and R_w. $R_s = R_n \cup R_u \cup R_w$ where
   - Correctly defined terms $R_n \subseteq R_e$,
   - Not accurately defined terms $R_u \not\subset R_e$ but

     $$\forall r_i \in R_n \exists r_{j_1} \in R_e, ..., r_{j_m} \in R_e, r_{j_k} \in R_e, m = \overline{1,k}$$

     , and
   - Incorrectly defined terms $R_u \not\subset R_e$ and

     $$\forall r_i \notin R_n \neg \exists r_j \in R_e \,.$$

5. Analyze the use of ontology terms and relations. We don't consider the use of terms from T_w and relations from R_w. Iit`s very important to take into account the type of relations – hierarchical or improper: Mistake of use "is a part" relation instead of "is a subclass" is much less principle then use "is a sinonime" relation instead of "is a subclass" one.

7. CLASSIFICATION OF MISTAKE TYPES IN STUDENT ONTOLOGIES

We distinguish the mistakes of different gravity. If student uses improper relation but from group of hierarchical relations (for example, A is a part of B instead of A is a subclass of B - Fig.4) it is not so important as if she or he uses hierarchical relation instead of synonymic relation (for example, A is a part of B instead of A is a synonym of B - Fig.5).

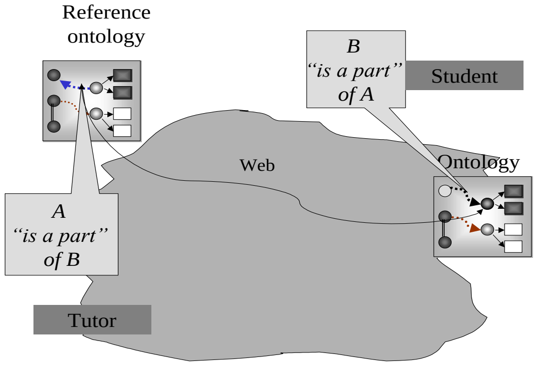

Fig.2: Hierarchical direction class error

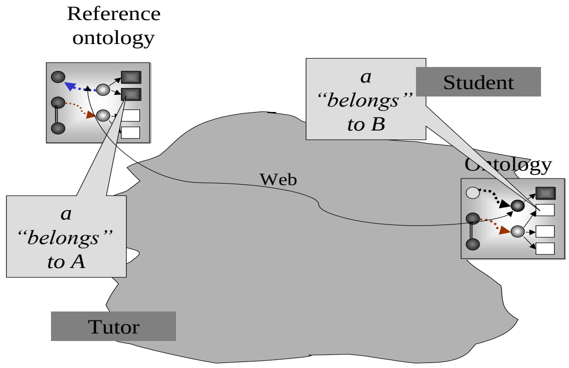

Fig.3: Instance classification error

More serious mistake is improper direction of hierarchical relations (for example, A is a part of B instead of B is a part of A - Fig.2).

On base of this algorithm we grade the results of students work with 100-ball system. The experimental prototype of system that controls student's knowledge by means of ontological analyses in URAN network was developed by Java.

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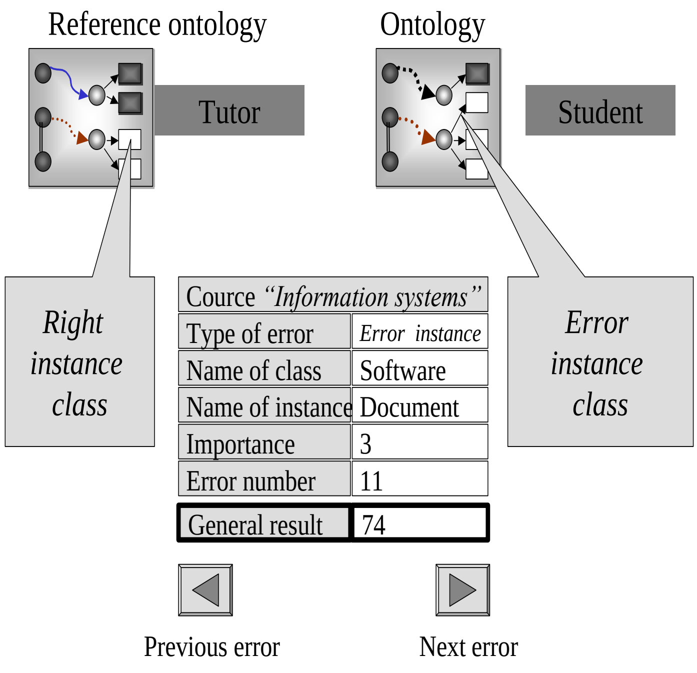

Fig.6: Rating of the student ontology correctness

8. RESULTS AND FUTURE WORK

Ontological representation of student domain skills can be automatically processed by intelligent software agents [16]. It is appropriate to use software agents for e-learning because they work efficiently in dynamic heterogeneous distributed environment [17]. One of the main properties of an intelligent agent is sociability. Agents are able to communicate between themselves, using some kind of agent communication language, in order to exchange any kind of information. In that way they can engage in complex dialogues, in which they can negotiate, coordinate their actions and collaborate in the solution of a problem. A set of agents that communicate among themselves to solve problems by using cooperation, coordination and negotiation techniques compose a multi-agent system (MAS). A lot of researchers use MAS for e-learning and e-coaching tasks.

Personalized e-learning employs an active learning strategy which empowers the learner to be in control of the context, pace and scope of their learning experience. It supports the learner by providing tools and mechanisms through which they can personalize their learning experience. This learner empowerment and shift in learning responsibility can help to improve learner satisfaction with the received learning experience.

The aims of personal e-learning agents are at increasing of information dissemination of existing courses through delivering the relevant course information offer to the right student at the right moment. For example, students of different specialties learn on different programs and in many cases have different theoretical and practical background. Their personal agents can consider it and propose them not only the universal course program but additional facts and references from allied courses that they didn't learn.

Application of agent-based technologies in e-learning provides the personification of students and tutors and saved all users from the routine operations.

An architecture of multiagent e-learning MAS M(e)L is proposed (Fig.7). It includes personal agents of students and course tutors. Use of some agents-facilitators raises the efficiency of this system and helps to users in search of required information. Agents of students and tutors don't communicate directly. They send ontological information to informational agent that analyses them and returns the results to students and tutor.

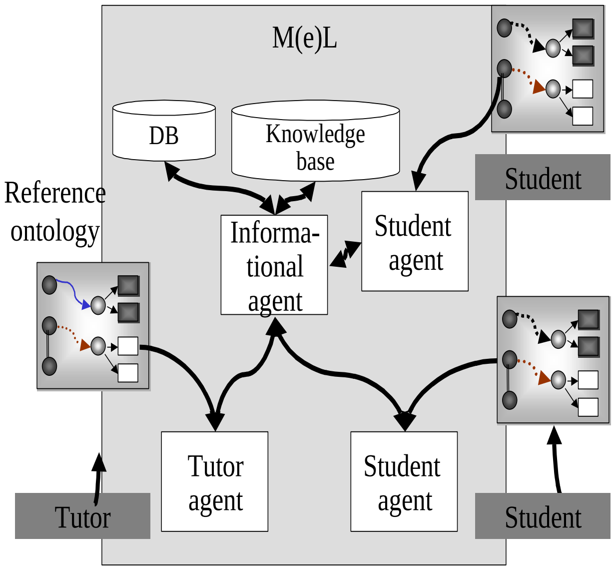

Fig.7: Architecture of e-learning MAS M(e)L

M(e)L prototype is a multiagent ontology-based e-learning system that produces automatically semantic control of student domain beliefs of learned course. The focus of ontology analysis is on knowledge structuring (of main domain terms and their relations). We use ontologies to describe learning materials and to represent student belief about course domain.

M(e)L includes:

1. Software agents of different types:
   - personal *student agents*;
   - personal *tutor agents*;
   - *informational agent* for communication support that facilitate users the DB and KB interaction;
2. *knowledge base* where ontological information about course is stored;

3. *data base* where personal information about users is stored;

Reference ontology is sent to M(e)L knowledge base by tutor personal agent.

When student forms the domain ontology in OWL format her/his personal agent connects not with course tutor personal agent but with informational agent and sends this ontology for comparing with reference one (its last version). After the comparing informational agent sends these results to the student and tutor personal agent. If some student or tutor usually prefers some manner of learning and information presentation then the personal agent has to provide all these requirements for new course without direct instructions of student. Student receives information in appropriate to her/him form and taking into account previous results of examination. For example, if student makes the same mistakes in some ontologies she/he receives the notification about it and advice that links with suitable course materials.

In future we plan to use the inductive inference methods to form the most appropriate personal strategy of learning for every student (for example, some students profit by theoretical materials and some other ones - from examples or practical tasks, somebody prefers graphical or text representation of information, etc.).

Use of student personal agent allows to find the situation where student makes mistakes of the same type in ontologies of different courses. She/he receives the notification about it and advice that links with suitable logical course materials. Other important advantage of multiagent technology use is deals with course tutor personal agent. If the big part of students make the same mistakes course tutor receives the notification about it and can change suitable course materials

A first version of the multi-agent system has been implemented. Prototype of M(e)L was realised on base Java library of AWT-Abstract Window Toolkit (Fig.8).

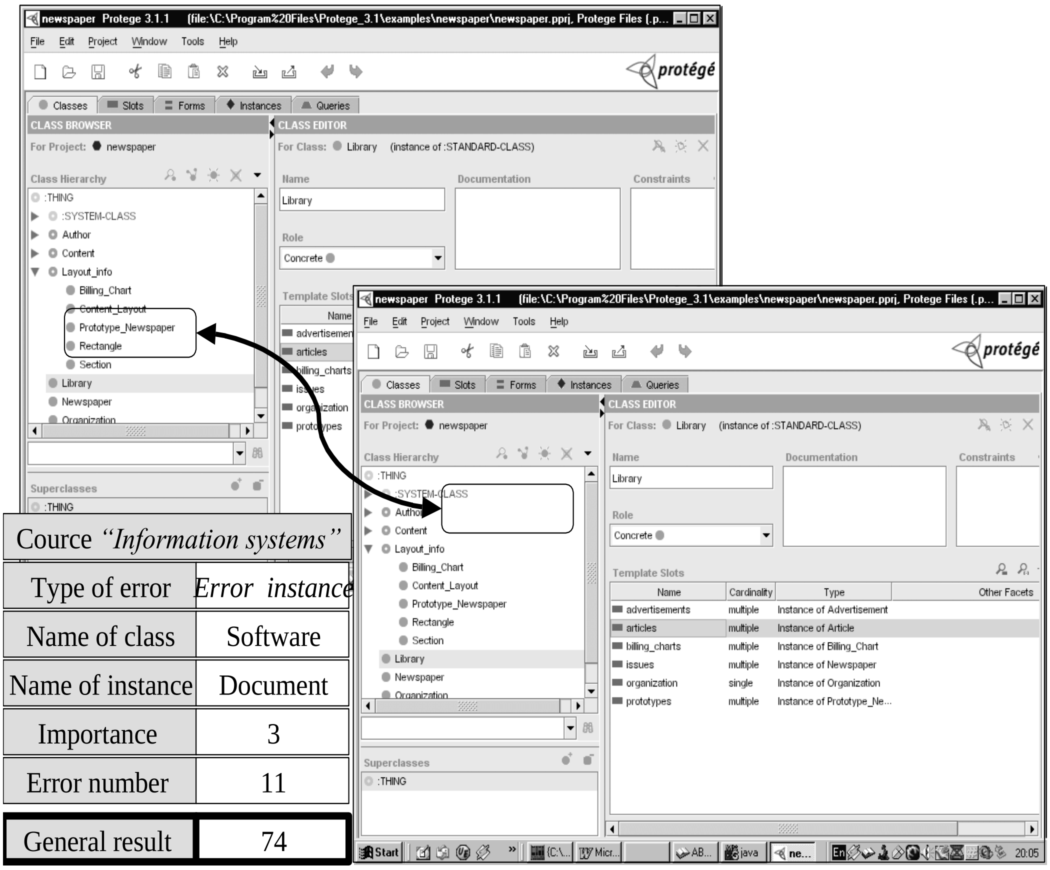

Fig.8: Domain ontology building and matching with reference one in M(e)L

We have been experimenting with the challenges of e-learning MAS M(e)L exploiting for student beliefs control in course "Visual C++ System Programming" (European University, Kiev, www.eufimb.edu.ua) and "Modern Internet Technologies" (Kiev Slavistic University, www.mgi_ksu .edu.ua). Detailed domain models of these courses have been constructed. Model of course "Visual C++ System Programming" contains more then 150 terms and uses 8 relations between these terms. Course is accompanied by 16 online lectures and 10 practical exercises. Model of course "Modern Internet Technologies" contains more then 68 terms and uses 10

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relations between these terms. Course is accompanied by 18 online lectures and 6 practical exercises (Table 1).

Table 1: Average measures of student ontology parameters

Course title	**"Visual C++ System Programming"**	**"Modern Internet Technologies"**
Number of students	22	16
Number of terms	153	68
Number of relations	8	10
Terms correctly used in student ontology K_{term}	94.2%	91.6%
Relations between terms correctly used in student ontology K_{rel}	72.0%	66,3%
Type of relations between terms correctly used in student ontology K_{type}	89.1%	81.5%
m_{term}	0.9	0.7
m_{rel}	0.3	0.5
m_{type}	0.7	0.8
Overall rating of student ontology correctness K	88,51%	80,14%

$$K = (K_{term} * m_{term} + K_{rel} * m_{rel} + K_{type} * m_{type}) / (m_{term} + m_{rel} + m_{type})$$

9. USE OF DOMAIN ONTOLOGIES FOR COURSE FORMALIZATION IN TEMPUS

Reference ontologies of courses can be used in future for course standartization and comparison. This problem appiares in process of TEMPUS project. The organisation of an OPEN “international master degree event” in Amman and one in Varna. Partners who already planned collaboration with Uhasselt and other partners in the network for a joint organisation of a master programme will present their master. This event can be seen as a marketplace where project partners present their programmes and other universities from the two regions will be informed about possibilities for their students to enter in a master degree in MIS.

This project deals with set of courses in MIS and BI domain to be included in the curriculum Master degree in MIS and required topics to be included to guarantee the equivalence of them between the partners.

Research about existing courses of the partners demands means and tools for formalization of course knowledge and representation. Course ontology is an interoperable adequate mean for domain knowledge representation, and Semantic Web provides languages and tools for ontology creation and processing.

Some words about TEMPUS purposes. Special focus for the theory must be on the new evolution in international information systems in a global economy.

The curriculum that would be build must be also fitting the actual situation in different countries. ng materials

Information about content of some courses will be gathered the course contents from all partners.

After the identification of topics to be included in course and the inventory of existing learning materials in courses of the partners this information has to be integrated. All members of the workshop will put their learning materials at the other members’ disposal in this forum. Project works with next courses:

- Course 1: Business Intelligence (decision support systems)
- Course 2:Knowledge discovery management
- Course 3:Business process modelling
- Course 4: ERP systems
- Course 5: ICT management.
- Course 6: e-business strategy.
- Course 7: Strategic information management.
- Course 8: ICT governance, audit and ethical aspects.
- Course 9: Knowledge management.
- Course 10: System architecture and engineering.

Another activity of TEMPUS - model curricula masters degree in MIS and preparatory programmes, fitting the local requirements of the partners on point of number of ECTS credits and foreknowledge of students and the formulation of the other admittance criteria. Research on point of:

- Validation of the local credits into the ECTS credit
- The existing models of master curriculum models in the partners universities
- Foreknowledge of candidate master students
- Validation of the local credits into the ECTS credits

The goal it to transfer all the credit systems into the ECTS credit system; Partner universities can use there own system but for every course the credits need to be stated in

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ECTS credits as well; The comparison will be made based on the related workload;
The next steps - design of a model preparatory programme and conception of bi- and multi-degree solutions and about possible partnerships. Following the European regulations it is possible to implement a double or bi-degree on master level if both universities have a Master degree and agree on the equivalence of them. The student has to stay for minimum 1/3 th of the courses in the other university. But there is a problem how to establish some correspondence of different courses.
In the new global economy companies have the challenge of going international and changing to real international companies. As part of their international strategy the enterprise systems have to be re-engineered to support the new business processes and to support the worldwide communication and information exchanges. A joint International course project will be a part of a master course in MIS / BI and an international student event.

10. SUMMARY AND CONCLUSION

The main features of our approach to knowledge control are the following:

- all results are analyzed automatically without tutor;
- results are analyzed objectively;
- students can work with knowledge base;
- a structurization of domain knowledge simplifies the learning process;
- tutors can exchange their knowledge based on reference ontologies.

One of the essential elements needed for effective learning is feedback. In the current generation of e-learning systems automatically produced feedback is almost only used in question-answer situation. Valuable feedback, for example produced by a human tutor via e-mail, is often possible but this introduces delays and is time consuming. We want to develop ontology-based mechanisms of feedback that use the context of education. Different student errors need different methodologies of tutor to describe their causes.
Feedback is used in many learning paradigms. The concept of feedback is very important in educational psychology. It is one of the main psychological principles that one of the essential elements needed for effective learning is feedback. Information about examining results is required to assess progress, correct errors and improve performance. Feedback describes any communication or procedure given to inform a student of the accuracy of a response, usually to an instructional question. Feedback allows the comparison of actual performance with some set standard of performance. Information that is acquised by student from feedback instruction includes not only answer correction but other information such as precision, timeliness, learning guidance, motivational messages, background material, sequence advisement, critical comparisons, and learning focus. In traditional learning students and tutors can interact directly and students can freely ask questions and tutors usually know whether their students understand concepts or problem solving techniques and relations between them. Feedback is an important component of this interaction. In e-learning systems feedback problem is much more difficult and has a lot of technological and social aspects.
In future, we plan to develop more powerful algorithms of ontology analyses that consider ontology integration and their distributed upgrade on base of multiagent technologies. Application of student and tutor agents will provide the personalization of distributed learning process. These agents will use the history of learning for feedback between student and tutor.

ACKNOWLEDGEMENTS

This work was supported in part by the Grant NATO NIG 971779."National Telecommunication Networks for Scientific and Educational Institutions of Ukraine with Access to Internet - URAN" and EU INCO-Copernicus Project 960114 – EXPERNET "A distributed Expert System for the Management of a National Network of Ukraine”.

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