

Assessment tool based on semantic content annotation

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Abstract – This paper describes system for students' knowledge assessment which is based on the technologies of the Semantic Web. This framework is a follow-up of the development of DSI (Drag and Drop Semantic Interface) tool for e-learning with the important difference that document for semantic annotation of teaching materials serve as the basis for creating questions for knowledge tests. The aim of the project described in this paper is software that enables creation of individualized knowledge tests, depending on the predefined semantic relations between terms in the teaching material. The paper gives a brief overview of the previously implemented versions of the DSI framework. The architecture of the implemented system and a description of the user experience of using this system are presented.

Keywords – Knowledge Assessment, E-learning, Semantic Web, DSI.

I. INTRODUCTION

In this paper we present an approach of using Web technologies (Web 2.0 and Semantic Web) to create framework for e-learning. This approach to learning is enhanced with additional true-false semantic relations between notions in order to use it as a knowledge assessment tool.

Use of the well-known DSI principle of semantic annotation of learning materials can be applied to assess students' knowledge. The aim of the application described in this paper is use of semantic layer as a basis for creating questions required for testing knowledge. Constantly adding new relations in semantic document is one of the advantages of this approach. That simultaneously increases the number of questions that can be used in knowledge tests.

E-learning can be defined as delivery of teaching materials to students using computer technology as a tool for transferring knowledge. In the basis of E-learning is individualized and dynamic approach to the creation of learning materials. This means that it is necessary to distribute teaching materials to student at the time when it is needed and in the quantity needed. On the other hand, the Semantic Web represents a vision of the Web as an environment that allows "machines" to automatically acquire, integrate and process data. And then based on these data programs can fully autonomously reach conclusions that will be presented to users on their request. [1] DSI concept of learning is positioned at the intersection of the fields of E-Learning and Semantic Web. The concept on which this framework is based allows completely individualized delivery of semantic

relations depending on the terms in the teaching material that are crossed (crossing terms means making connection between terms using drag-and-drop action). Delivery of additional knowledge or semantic relations between terms in the teaching material is enabled on the user's request, using drag-and-drop action. This tool has been developed using Semantic web technologies. Semantic Web technology provides the ability of using semantic layer for the purpose of creating questions for knowledge tests. [2]

In this paper term semantic annotation is used for explaining the process of enabling users to get some extra information about the relations between notions in the teaching material. Semantic annotation can be defined as a specific metadata generation and usage schema, which is aiming towards enabling new methods for accessing information and extending the existing ones. [3] Also as an annotation assigns to an entity, which is in the text, a link to its semantic description. [4] In simpler terms it represents the process of enhancing entities, found in the text, with additional information about them or relations between them. Calling this annotations "semantic", "entity" or in some other way it is just matter of terminology. [3] DSI relies completely on this component, connecting data by meaning, and enabling users to get some extra information about relationships between two entities. Terms, which can be found in textual teaching material, are kept in semantic document as resources. These resources combined with additional information form structures similar to sentences called statement (subject-predicate-object). Statement structure is the basis of Semantic Web applications, so this kind of term annotation of textual teaching material comes very naturally and is to be expected.

The development of the DSI tool will be briefly described further in the paper. Furthermore, implemented system for students' knowledge assessment will be described in detail and also the possibilities of using this tool.

II. DEVELOPMENT OF DSI TOOL

DSI (Drag and Drop Semantic Interface) is a system developed to support e-learning. It was developed in the CIITLAB laboratory, at the Faculty of Electronic Engineering and aims to improve the existing systems for e-learning. [5] This system, using the Semantic Web technologies, provides the users with the possibility of making connections (relations) between terms in textual teaching material. Making connections is achieved by simple and intuitive interface to the user, dragging one term onto another (drag-and-drop action). [6] [7] Framework is still under development, there have been developed several versions of the system in which the emphasis was on learning acceleration using this concept. In the first version (1.0 and also version 1.5) system provides one-way communication with the user. It is possible to drag and drop terms on each other and as a result of this action relations stored within the semantic document are presented to

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the user. In version 2.0 two-way communication with the user is achieved, in addition to learning users can participate in the creation of semantic documents, adding new relations between terms. Versions 1.5 and 2.0 are recognized by the Faculty of Electronic Engineering in Nis as technical solutions in the field of software. [8] [9] Figure 1 shows a demo version of the application DSi 1.5.

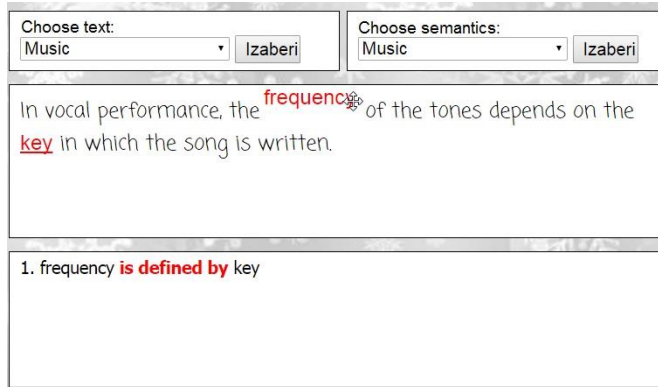


Fig. 1. Preview of demo application DSi 1.5

A system for testing DSi concept in real operating learning conditions has also been developed. This system monitors and records all user actions during the whole session of learning. It is essentially based on the version 1.5 of DSi framework with the addition of modules for tracking users' actions and for testing knowledge. This system has been designed as a Web application in which students are presented with learning materials and in addition with the possibility of dragging and dropping terms on each other. At the same time questions related to the lesson are presented to them. The basic idea was to create a learning environment in which there is a standardized knowledge tests in order to examine the impact of the proposed concept to learning acceleration. Figure 2 shows system for evaluating DSi tools.

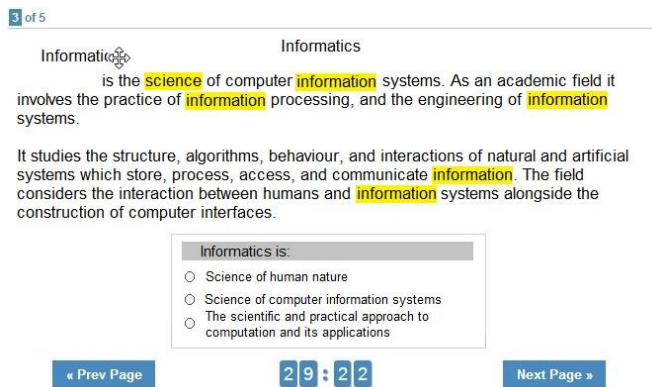


Fig. 2. System for evaluation of DSi tool

III. KNOWLEDGE ASSESSMENT

DSi-A (Drag and Drop Interface Semantic Assessment) is follow-up of the development of the DSi framework, with the important difference that in this version the concept of dragging and dropping terms on each other is used to evaluate knowledge and not just for learning. Approach to learning by dragging one term to another is combined with possibility of choosing one of the presented relations after crossing two terms. The user can select one of several presented relations. Action of selecting one relation means that user believes that selected relation is properly defined, which means that the other provided relations are incorrectly defined. This tool can be defined as a concept of evaluation of students' knowledge by combining the technologies of the Semantic Web (use of RDF for storing information, i.e. semantic relations in form of resources) and crossing terms in learning materials on a web page (drag-and-drop functionality). Use of these technologies form a unique test that is used for assessing students' knowledge based on pre-defined criteria. DSi-A is designed as a stand-alone Web application, but the concept is applicable to any system for e-learning, which allows preview of teaching materials as textual lessons.

This concept of using DSi tool was first introduced in [10]. As part of this paper the initial concept of knowledge assessment by using connections between terms stored in semantic document was presented. During the implementation of this framework there have been made some changes, specifically the manner in which the relations will be kept within the RDF document as well as the manner in which correct and incorrect relations will be classified for easing the process of checking the accuracy of user responses. As already has been said this system is still under development and is expected to make certain changes in further development.

Further in the paper we present the architecture of the implemented system and DSi assessment tool user experience.

The basic components of this application, as in previous versions of the DSi system are client and server sides. Client-side of the system is implemented in JavaScript, it is used to display teaching materials and to enable the functionalities needed for human-computer interactions. The server side is implemented in PHP, and is responsible for all application logic related to semantic documents and replying to requests received from the client.

It is planned that the system has two user groups: students (whose knowledge will be assessed) and teachers (who will create a semantic documents for testing). Given this division and previous versions of the application, architecture is divided into three subsystems: module for creating new semantic relations, module for the assessment of knowledge and a module for tracking user actions. In the subsystem for creating relations between terms the user is prompted to enter new relations and to define which of those relations are correct, the rest are declared faulty. Knowledge assessment subsystem relies on recognition of right or wrong-defined relations. Subsystem for monitoring user actions was first presented as part of a system for evaluating DSi tools for e-

learning in the paper [11]. This subsystem relies entirely on the architecture of mentioned system.

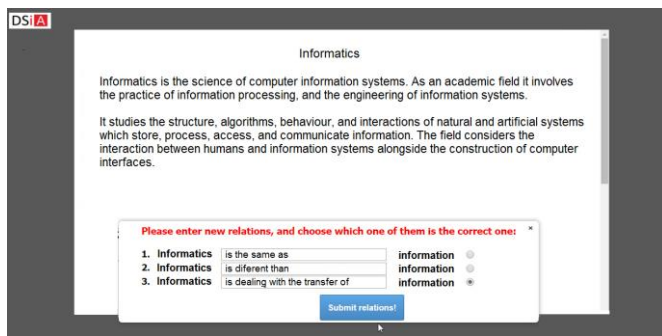


Fig. 3. Adding new relations to semantic document, the definition of correct/incorrect relations

The process of preparing teaching materials that will be used for knowledge assessment purposes, consists of preparing two documents: textual lessons and semantic document (RDF document with relations between terms). The lesson needs to be prepared in HTML format. It is kept on the server and is fully delivered to the client at startup testing. Semantic document is used for storing the connections between terms in the teaching material.

The teacher creates this document as a basis for testing students' knowledge. In this document, there are two types of relations between terms: correct and incorrect relations. With each of these relations information about whether it's correctly defined or not are also kept. After dragging and dropping the term on to another to user are presented relevant relations saved in this document. The entire document is never fully available on the client, but only some parts that are required on drag operation. In this way it is provided an additional level of security of semantic layer.

It is planned that the semantic documents preparation is done by teachers, people who are versed in the subject, i.e. people with sufficient knowledge of the matter, which will be presented to students in the form of lessons. The teaching material is presented in textual format, and all the words in the lesson are draggable and droppable. Defining new relations is possible by dragging and dropping one word on to another. After crossing two words (terms) a form for creating new relations is shown on the web page. It is possible to enter a certain number of relations and it is crucial to define which relation is correct. All other relations will be automatically declared as incorrect (Figure 3). System also gives the possibility of deleting the defined relations. If a teacher wants to delete relations already defined, crossing the same terms system will display those relations as well as the option to delete them.

Assessment of students' knowledge is planned as finding as many correct relations between key terms in prepared lessons, as well as the identification of those relations that are incorrectly defined. As mentioned above, for now it is possible to drag all words in the text, and the student needs to recognize which two terms can be related. Depending on the existence of terms crossed in the semantic document, response to student request will be formed. As a response to this action to them will be displayed a certain number of predefined relations. Figure 4 shows the layout of a web page after crossing two terms. The student can respond by selecting one of these relations as the only correct one from all relations presented. If student believes that he was offered only with faulty (incorrectly defined) relations he can answer that none of them is correct. Of course it is possible to cancel answering to this question if the student is not sure what a good answer is. Each of these actions will be stored in a database so that after the end of the session certain conclusions can be reached based on the data collected.

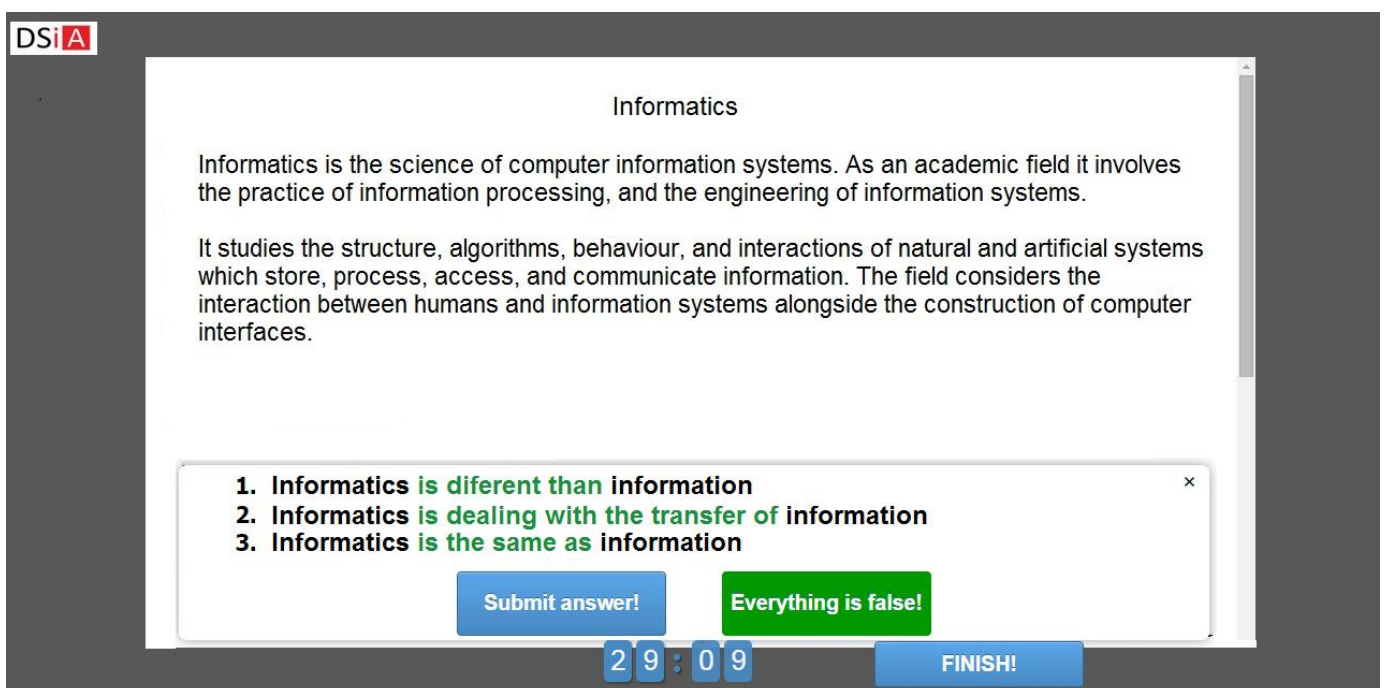


Fig. 4. Web page after crossing two terms, answering to the question presented

IV. CONCLUSION

DSi-A represents a tool which can be used for assessing knowledge of the individual and his progress in learning. User progress can also be compared with a certain predefined criterion. Collecting information about users while using the system and combining and analyzing those information can be used to assess their knowledge. Assessing students' knowledge is planned as finding as many correct relations between the key terms in the prepared lessons, as well as the identification of those relations that are incorrectly defined. This system also enables the preparation of semantic documents for use in the knowledge tests. The idea is that domain experts with sufficient knowledge of the subject participate in the preparation of these documents necessary for a knowledge test. Every test for each student is completely individualized and depends only on the selection of relations in the lesson. The questions that will be presented to students depends precisely on that selection and also on crossing those selected terms from the teaching material. The concept of such standardization of questions for knowledge tests provides the possibility of later expansion of the system in the form of the introduction of automated reasoning and creating new relations based on pre-defined rules.

Further development of the system will go in the direction of separation of terms (words) that may be the key terms, or the separation of those words that makes no sense to drag (and cross with other terms) in a separate semantic document. It is necessary to implement a simple interface that would allow domain experts to easily and quickly add these words in new semantic document. The idea is that when creating semantic document the user can identify which words does not make sense to drag and depending on this to create a local "base" of these terms. It is necessary to allow quick and easy search of the document. After that it is planned to develop a central repository of those words that makes no sense to drag. For knowledge tests for the specific lessons it would be necessary to take segments of that central repository containing words that appear within the test.

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