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Creation of Web 2.0 tools ontology to improve learning

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ABSTRACT

The aim of the paper is to present systematic review results on ontology development tools, to establish interconnections between learning styles, preferred learning activities and related Web 2.0 tools, and also to create Web 2.0 tools ontology to interconnect learning activities with relevant Web 2.0 tools. This ontology is necessary for learners to semantically search for suitable Web 2.0 tools while learning in virtual learning environments (VLEs). Suitability of Web 2.0 tools depends on preferred types of learning activities which in its turn depend on preferred learning styles. The research results include: (1) systematic review results on ontology development tools and ontology representation language/formats; (2) established interconnections between learning styles, preferred learning activities, and relevant Web 2.0 tools using sets portrait method, and (3) creating Web 2.0 tools ontology to interconnect preferred learning activities with relevant Web 2.0 tools in VLE. The research results will be implemented in iTEC – pan-European research and development project focused on the design of the future classroom funded by EU 7FP. The research results presented are absolutely novel in scientific literature, and this makes the current study distinct from all other works in the area.

1. Introduction

The aim of the paper is to investigate and present systematic review results on ontology development tools, to establish interconnections between learning styles, preferred learning activities and related Web 2.0 tools, and to create Web 2.0 tools ontology to interconnect learning activities with relevant Web 2.0 tools.

The proposed approaches to solve the problem are systematic review, Triangular Fuzzy Numbers (TFN) method to select the best relevant ontology development tool, sets portrait method to interconnect learning styles, preferred learning activities and Web 2.0 tools in Moodle v2.2 virtual learning environment (VLE), and ontology creation using Protégé tool. The practical problem analysed in the paper is how to create the ontology for the semantic search engine necessary for learners to quickly and qualitatively find relevant Web 2.0 tools while learning in VLE Moodle. Suitability of Web 2.0 tools depends on preferred types of learning activities which in its turn depend on preferred learning styles.

One of the more recent developments with the Web is an activity known as the Semantic Web (or Web 3.0). The Semantic Web is not a separate Web but an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation (Berners-Lee, Hendler, & Lassila, 2001). Two important technologies for developing the Semantic Web are XML and RDF, and a third important aspect of the Semantic Web is a set of ontologies. Ontology is a specification of a conceptualisation (Gruber, 1993). It describes the concepts and relationships of some phenomenon in the world. By using well-defined ontologies on the Web, it is possible for computers to meaningfully process data since there is a common understanding of terms used and the relationships between these terms (Mohan & Brooks, 2003).

VLE is referred here as a single piece of software, accessed via standard Web browser, which provides an integrated online learning environment (Kurilovas & Dagiene, 2010). One of the main parts of each VLE is Collaborative Web (or Web 2.0) tools. Therefore, in order to improve the adaptation quality of VLEs it is very important to improve semantic search for Web 2.0 tools in VLEs. These tools support interaction, communication and collaboration amongst students and educators. As contemporary students are educational content creators, consumers and distributors via Internet it becomes obvious that Web 2.0 tools play an important role in VLEs and learning process.

In the paper, a special attention is paid to improving VLE suitability for different learning styles, i.e. VARK (Fleming,

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2001). The acronym VARK stands here for Visual (V), Aural (A), Read/Write (R), and Kinaesthetic (K). Fleming (2001) defines learning style as "an individual's characteristics and preferred ways of gathering, organising, and thinking about information. It is focused on the different ways that we take in and give out information.

A number of the other learning styles models were analysed in e.g. Beres, Maguar, and Turcsanyj-Szabo (2012), Dorca, Lima, Fernandes, and Lopes (2012), Lubchak, Kupenko, and Kuzikov (2012).

The rest of the paper is organised as follows: methodology of the research is presented in Section 2, research results are presented in Section 3, discussion – in Section 4, and conclusion – in Section 5.

Section 3 containing research results and is divided into three separate parts:

(1) Systematic review results on definition and the roles of an ontology, ontology development tools, and ontology representation language/formats.
(2) Established interconnections between learning styles, preferred learning activities, and related Web 2.0 tools using sets portrait method.
(3) Created Web 2.0 tools ontology to interconnect preferred learning activities with relevant Web 2.0 tools in VLE Moodle v2.2.

2. Research methods

In order to specifically find clear definitions and the roles of ontology, ontology development tools, and ontology representation language/formats, an exhaustive search conducting a Systematic Review was performed. This systematic review was conducted following the process proposed by Kitchenham, Dyba, and Jorgensen (2004) and Biolchini, Mian, Natali, and Travassos (2005). According to Biolchini et al. (2005), the term Systematic Review in software engineering is used to refer to a specific methodology of research, developed in order to gather and evaluate the available evidence pertaining a focused topic.

In contrast to the usual topic of literature review, unsystematically conducted whenever one starts a particular investigation, a Systematic Review was developed, as the term denotes, in a formal and systematic way. This means that the research conduction process of a systematic type of review follows a very well defined and strict sequence of methodological steps, according to aprioristically develop protocol.

This instrument is conducted around the central issue, which represents a core of the investigation, and which is expressed by using specific concepts and terms, that must be addressed towards information related to a specific, pre-defined, focused, and structured question.

The methodological steps, the strategies to retrieve the evidence, and the focus of the question are explicitly defined in Biolchini et al. (2005). According to Kitchenham et al. (2004), this process presents three main phases:

(1) Phase 1 – Planning: In this phase, the research objectives and the review protocol are defined. The protocol constitutes a pre-determined plan that describes the research questions and how the systematic review will be conducted.
(2) Phase 2 – Conduction: During this phase, the primary studies are identified, selected and evaluated according to the inclusion and exclusion criteria established previously. For each selected study, data are extracted and synthesized; and
(3) Phase 3 – Reporting: In this phase, a final report is formatted and presented.

In the paper, TFN method is used to select the best relevant ontology development tool. According to Kurilovas and Dagiene (2010), there is scientific evidence that this method is convenient for evaluating the quality of many different kinds of software alternatives in the market.

According to Ounaies, Jamoussi, and Ben Ghezala (2009), the wide-used measurement criteria of the decision attributes quality are mainly qualitative and subjective. In this context, decisions are often expressed in the natural language, and evaluators are unable to assign exact numerical values to different criteria. Assessment can be often performed by the linguistic variables such as "bad", "poor", "fair", "good" and "excellent". These linguistic variables allow reasoning with imprecise information, and they are commonly called fuzzy values. Integrating these different judgments to obtain a final evaluation is not evident. In order to solve this problem, Ounaies et al. (2009) suggest using the fuzzy group decision making theory to obtain final assessment measures. First, linguistic variable values should be mapped into non-fuzzy values. In the case of using the average TFNs, linguistic variables conversion into triangular non-fuzzy values of the software quality evaluation criteria should be as follows (see Table 1):

In order to obtain final evaluation results, one should use the experts' additive utility function, i.e. add all the numerical ratings (values) of the quality criteria multiplied by their normalised weights (Kurilovas & Dagiene, 2010). The major is the meaning of the utility function the better is alternative.

For establishing interconnections between the sets of learning styles, preferred learning activities, and related Web 2.0 tools sets portrait method was used.

Web 2.0 tools ontology to interconnect preferred learning activities with relevant Web 2.0 tools in VLE Moodle v2.2 was created using the best selected tool Protégé.

3. Presentation and discussion

3.1. Systematic review results

The *research questions* addressed were as follows: What kind of ontology definitions is given in the literature? Which existing ontology application area could be applied to develop technologies ontology based on learning activities? Which existing ontology development tool could be applied to develop technologies ontology based on learning activities? Which existing ontology development methodology could be applied to develop technologies ontology based on learning activities? Which existing ontology representation language could be applied to develop technologies ontology based on learning activities?

The *keywords and related concepts* dealing with these research questions and used during the review execution were as follows: ontology definition (what is an ontology/what are ontologies);

Table 1
Conversion of linguistic variables and into non-fuzzy values (according to Kurilovas and Dagiene (2010)).

Linguistic variables	Triangular non-fuzzy values
Excellent	0.850
Good	0.675
Fair	0.500
Poor	0.325
Bad	0.150

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