On Recommending Web 2.0 Tools to Personalise Learning

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Abstract. The paper aims to present research results on using Web 2.0 tools for learning personalisation. In the work, personalised Web 2.0 tools selection method is presented. This method takes into account student's learning preferences for content and communication modes tailored to the learning activities with a view to help the learner to quickly and accurately find the right educational tools, and to implement this method in prototype of knowledge-based recommender system. In the research, first of all, personalised e-learning technological peculiarities i.e. recommender systems applications for learning personalisation and those systems components were investigated. After that, selection methods for Web 2.0 tools suitable for implementing learning activities were analysed. The novel method of integrating Web 2.0 tools into personalised learning activities according to students learning styles was created, and prototype of the recommender system that implements the method proposed was developed. Finally, the expert evaluation of the developed system prototype that implements the method proposed was performed.

Keywords: Web 2.0 tools, personalisation, VARK learning styles, learning activities, ontology, recommender system.

1. Introduction

Personalised e-learning systems deal with appropriate personalisation techniques in order to maximise the effectiveness of learning. Personalised e-learning is an important research area of modern educational technology (Beres *et al.,* 2012; Dorca *et al.,* 2012; Lubchak *et al.,* 2012; Bennane, 2013).

Web 2.0 tools can be defined as web applications that facilitate participators' information sharing, interoperability, user-centred design, and collaboration on the World Wide Web (Kolesinski *et al.*, 2013, p.16).

There are plenty of Web 2.0 tools and examples of their use in education. Most of the researches focus on e-learning systems personalisation functionalities such as person-

alised learning plans and learning materials. Although in practice and in many sources of literature the need for the application of Web 2.0 tools in education is highlighted, however there is lack of clear methods how these tools could be applied in learning for a higher learning quality, and there is a lack of e-learning systems that implement these methods. Also, these tools are not always suitable for the task to which they are applied and they are not always properly used for a specific purpose. Furthermore, most of the e-learning systems are focused on the course rather than on the learner, which means that they do not satisfy users. In order to address these problems, learning environments must be more adapted to the learner.

In the paper, a developed knowledge-based recommender system prototype is presented. This system gives a possibility to develop personalised learning environment with better access to specific learning content managing tools (i.e. Web 2.0 tools). Thus it facilitates the search process by optimising workloads, improving the learner's satisfaction thereby as well as the efficiency and effectiveness of the learning process.

The rest of the paper is organised as follows. Section 2 presents the related research, Section 3 presents the method created and the recommender system prototype developed, and Section 4 presents the results of the expert evaluation of system created. Discussion is provided in Section 5, and conclusions and results – in Section 6.

2. Related Reseach

E-learning environment is a computer-based online learning system. It supports learner by providing opportunities to learn at the time and location according to the learner's choice and allows his/her interactions with other learners, as well as ensures access to a wide range of learning resources and tools. The e-learning environment, that provides a set of personalisation functionalities such as personalised learning plans and learning materials, and is capable of initialising the interaction with learners by providing suggestions to online learners, is called a personalised e-learning environment. One of the major challenges involved in developing personalised systems is to achieve effective personalisation functionalities such as personalised content management, the learner's model, and adaptive instant interaction. Adaptive systems, autonomous intelligent agents and recommenders provide an important technology for accomplishing personalisation in e-learning systems. Adaptive and intelligent technologies can enhance different sides of learning.

Adaptive hypermedia systems build a model of the goals, preferences and knowledge of each individual user, and use this model throughout the interaction with the user, in order to adapt to the needs of that user (Brusilovsky, 1996). The goal of intelligent agents and recommenders is the use of knowledge about the domain, the learner, and the learning process to support personalised learning, i.e. to improve the learning activities.

Recommender systems (as a kind of services in the e-learning environment) can provide personalised learning recommendations to learners. Recommender systems are information processing systems that gather various kinds of data in order to create their recommendations. The data are primarily about the items (objects that are recommended) to be suggested and the users who will receive these recommendations (Ricci *et al.*,

2011, p.7). The data can be formalised in a domain ontology, thus the knowledge about a user and items becomes reusable for people and software agents (Li *et al.*, 2007; Youn and Mcleod, 2006; Wang and Huang, 2013; Vesin *et al.*, 2013; Vesin *et al.*, 2012; Chen *et al.*, 2012). Ontologies can support the definition of such components of recommender system (Buriano *et al.*, 2006):

- The context features and the candidate items.
- The output.
- The recommendation process.
- Functional modules.

Such information modelling can contribute to tailor the right information to a user and thus facilitate the user-system interaction.
The suggestions relate to various decision-making processes.

The user profiling process generally consists of three main phases (Gauch *et al.*, 2007):

1. Information collection: the process that is used to gather raw information about the user. Depending on the information collection process selected, different types of user data can be extracted.
2. User profile construction (from the user data). There is a variety of ways in which profiles may be represented and constructed.
3. Information in the user profile exploitation. It is done by technology or application in order to provide personalised services.

User profile construction is typically either knowledge-based or behaviour-based (Middleton *et al.*, 2009). Knowledge-based approaches use static models of users and dynamically match users to the closest model and that of behaviour-based apply the user's behaviour as a model, commonly using machine-learning techniques. To obtain behaviour-based knowledge, behavioural logging is used, and knowledge-based approaches often use interviews and questionnaires for gathering knowledge.

In e-learning systems, learner's profiles can be modelled (for personalisation purposes) by several techniques (Dagger *et al.*, 2002) as follows:

- Creating fixed stereotypes: learners are categorised, and the system customises their performance based on the category that has been set for the learner.
- Constructing learner's knowledge: a model of the learner's knowledge is constructed on the concept-by-concept basis and updated with the progress of the user through the system.
- Combined techniques: the learners are categorised by stereotype initially and then this model is gradually modified, based on learner's interaction with the system.

User profiles can be represented as sets of weighted keywords, semantic networks, weighted concepts, or association rules (Gauch *et al.*, 2007). The keyword-based profiles are often represented as vectors of weighted features.

As mentioned before, one of the features of contemporary e-learning is personalisation because learners should be treated as individuals with differences such us learning styles. The term 'learning style' refers to the concept that individuals differ with regard to which mode of instruction or study is most effective to them (Pashler *et al.*, 2008).

Various learning style models are developed. In the work of Coffield *et al.* (2004), there is a detailed analysis of the best known learning style models. In (Popescu, 2009), a summary of learning preferences extracted from learning style models (by the main features) is presented. These preferences can be, for example, a specific manner of approaching a learning task, learning strategies activated in order to fulfil the task, preferable ways of gathering, organising, or thinking about information.

VARK learning styles model designed by Fleming in 1987 is an acronym made from Visual, Aural, Read/write and Kinaesthetic. These modalities are used for preferable ways of learning (taking and giving out) information. Visual learners prefer to receive information from depictions in figures: in charts, graphs, maps, diagrams, flow charts, circles, hierarchies, and others. It does not include pictures, movies and animated websites that belong to Kinaesthetic. The aural perceptual mode describes a preference for spoken or heart information. Aural learners learn best by discussing, oral feedback, email, chat, discussion boards, and oral presentations. Read/write learners prefer information displayed as words: quotes, lists, texts, books, and manuals. The kinaesthetic perceptual mode describes a preference for reality and concrete situations. They prefer videos, teaching others, pictures of real things, examples of principles, practical sessions, and others. Multimodals are those learners who have preferences in more than one mode (Fleming, 2006).

There are different types of recommender systems, based on the recommendation approaches. Rule-based reasoning method is the fundamental in knowledge-based recommendation systems (Husain and Dih, 2012; Jadhav and Sonar, 2009). It is deductive and the knowledge base comprises the knowledge that is specific to the domain of the application (Jadhav and Sonar, 2009). The Rule-based reasoning system represents knowledge of the system in terms of a set of rules (facts) (Kapoor *et al.*, 2010). These rules are in the form of IF THEN rules such as "IF some condition THEN some action". If the 'condition' is satisfied, the rule will take the 'action'.

In order to construct rules of learning tools (i.e. Web 2.0 tools) recommendation, research on the relationship between these tools and the learning process (i.e. existing learning tools selection models presented in literature) was conducted. Results of this analysis are presented in Table 1.

3. The Method for Integrating Web 2.0 Tools into Learning Activities

When planning the learning process, first of all we have to set the learning objective (or outcome). One of the basic and essential elements within the education community is a classification of learning objectives (especially, cognitive) in education, presented by Bloom (1956) is Bloom's taxonomy. The learning objectives can be achieved through a sequence of tasks, performed by the learner. These tasks form a learning method.

The Learning 2.0 allows learners to use Web 2.0 tools, to take an active role in the learning process, and to determine their own learning strategies according to their interests and needs. Active learning methods and Web 2.0 tools can enhance the learning effectiveness, however, it is important to consider each learner's individual prefer-

Table 1

Models of learning tool selection

Reference	Model
Conole and Fill, 2005	According to authors learning activity as an action which occurs within a context with a set of associated attributes and addresses a set of learning outcomes. These outcomes can be achieved through a sequence of tasks and associated roles adopted by the learners which might call upon a set of tools and resources. The toolkit developed by authors offers appropriate media based on the media category (e.g. Adaptive, Productive), the desired learning outcomes (e.g. understand, demonstrate, design, produce, appraise) and strategies (tasks).
Bower *et al.*, 2010	According to the author, for the proper tool selection it is needed to consider the following four element groups of the learning design:
	• The overarching learning goals and objectives (outcomes)
	• The type of content in terms of knowledge to be represented and cognitive processes in which students are expected to engage
	• The type of pedagogy to be applied (transmissive, dialogic, constructive, co-constructive)
	• The preferred modalities of representation (text, image, audio, and/or video), the type of collaboration, and the level of synchronicity required.
	Then, based on these elements, matched to the Web 2.0 tools potential to satisfy these requirements suitable Web 2.0 tools can be selected
Starkey, 2011	According to the author, for the proper tool selection it is needed to combine digital tools use (accessing information, presenting, processing information, gaming or interactive programs) with the aspects of learning (doing, thinking about connections, thinking about concepts, criticising and evaluating, creating knowledge, sharing knowledge).
Khalid *et al.*, 2012	According to the authors, in the view of the proper tool selection it is needed to map tools with the problem-and-project-based learning activities that include the tasks (e.g. brainstorming, argumentation, literature storing) performed by learner to achieve learning outcomes in a learning environment while interacting with people or resources.
Vega-Gorgojo *et al.*, 2008	According to authors, selection of suitable tool for learning activity accomplishment needs to map a particular tool with a desirable task to perform. The authors state that the tool supports one or more learning tasks (person-based, group-based or computer-system-based) performed by an actor (person, group or computer system) who can play some role (e.g. editor, communicator, publisher). Tasks are divided into five types: Perception, Construction, Communication, Computation and Information Management. The realisation of these tasks may require an artefact (e.g. document, vote) as input or may produce an artefact (e.g. message, calendar) as output.

ences. Personalisation deals with this kind of problem. This work takes into account the learner's preferences to the educational material (based on VARK learning styles model) and communication modes.

The proposed method for Web 2.0 tools integration into the learning activities was implemented in prototype of the system. This prototype has been developed following the working principles of the knowledge-based recommender system. The domain knowledge was conceptualised in the ontology. Sub-section 3.1 presents the basic elements of developed ontology. The proposed method is introduced in Sub-section 3.2.

3.1. *Description of the Basic Elements of the Proposed Method for Integrating Web 2.0 Tools in Learning Activities*

With the view to find a particular Web 2.0 tool suitable for learner (for learning activity accomplishment), a link between the tool and the learning activity must be identified. This relationship can be established by interconnections between the defined tool and activity elements.

The learning activity is defined as consisting of the following elements:

1. Learning Activity (what action a learner performs).
2. Content (which object a learner manages).
3. Interaction (with whom a learner interacts).
4. Synchronicity (at what time a learner performs the intended action).

Web 2.0 tool is defined as set of universal functions. This universal function is defined as consisting of the following elements:

1. Function (what action can be performed by using a tool).
2. Artefact (which object (information format based on VARK) can be managed by using a tool).
3. Interaction (what kind of interaction the tool enables).
4. Synchronicity (at what time the intended action is enabled by a tool to take place).

The learning activities and functions of tools are classified mainly based on the Conole and Fill (2005) media taxonomy. These types and particular elements are presented in Table 2.

Thus, Web 2.0 tools could be divided based on their usage possibilities, managed objects, communication form, and sort of imitation process into three groups as follows:

1. Artefacts management (including narrative, productive and information management).
2. Communication.
3. Imitation tools.

Table 2

Learning activities and Web 2.0 tool function types

Type	Learning activities	Subtype (1–8)	Web 2.0 tool function
Narrative	Revise	1 – View	Explore (Read, view, listen)
Information management	Find Collect	2 – Search 3 – Host	Search Host (Store), Syndicate
Productive	Prepare	4 – Create	Create (draw, write, record, edit)
Communicative	Present Dispute	5 – Share 6 – Discuss	Share, publicise Communicate
Imitative	Role play Observation	7 – Imitate 8 – Model	Simulate (Game simulation) Model (Phenomenon modelling)

For domain knowledge conceptualisation we have used OWL DL (one of the three species of OWL) which can be viewed as expressive Description Logics, with an ontology being equivalent to SHOIN(D) Description Logic knowledge base (Horrocs *et al.*, 2003) and being decidable (Motic *et al.*, 2005).

Also, in the current study, we develop an ontology mainly based on the (Fernández *et al.*, 1999) METHONTOLOGY method which proposes such activities:

1. The specification activity (states why the ontology is being built, what its intended uses are and who the end-users are).
2. The conceptualisation activity (developing an ontology conceptual model).
3. The formalisation activity (transformation of the conceptual model into a formal or semi-computable model).
4. The implementation activity (creating computable models in the ontology language).
5. The maintenance activity (evaluation, corrections and updates).

During the specification activity, Uschold and King (1995) propose the strategy for identifying the main concepts in the ontology: a top-down approach where the main abstract concepts are identified and then specialised into more specific concepts; and (Gruninger and Fox, 1995) suggest to identify a set of competency questions that must be answered by a model built based on the ontology. The ontology must be able to provide a vocabulary for expressing these questions. Axioms in the ontology should be able to characterise the answers to the competency questions. Ontology evaluation can be seen as evaluation of the properties (e.g., language conformity (Syntax) and consistency (Semantics)) of ontologies generated by development tools (Sure *et al.*, 2003, p.7).

We have defined the following components in the domain ontology visualised with *Protégé 4.3* ontology editor:

- Concepts (Main Classes) (Fig. 1).
- Relationships between Concepts (Properties) (Fig. 2).

Domain and range of properties are presented in Table 3.
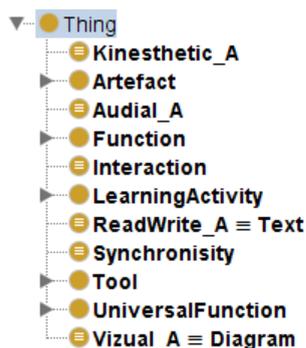
Fig. 1. The main ontology classes.   Fig. 2. Ontology properties.
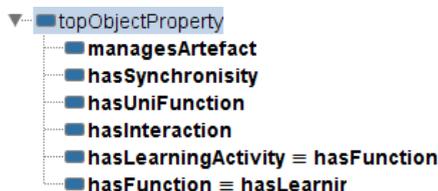
Table 3
Domain and range of properties

Property	Domain	Range
hasUniFunction	*Tool*	*UniversalFunction*
hasFunction = hasLearningActivity	*UniversalFunction*	*Function*
managesArtefact	*UniversalFunction*	*Artefact*
hasInteraction	*UniversalFunction*	*Interaction*
hasSynchronisity	*UniversalFunction*	*Synchronisity*

3.2. *The Steps of the Method for Integrating Web 2.0 Tools in Learning Activities*

These steps are as follows:

- Identification of student's learning style (i.e. preferences of the learning content and communication modes).
- Selection of the learning objective and the learning method.
- Determination of the elements of the learning activities according to chosen learning method.
- Determination of universal function elements of each Web 2.0 tool.
- Finding the link between Web 2.0 tool and learning activity elements.
- Selection of a suitable Web 2.0 tool based on specified elements: Action, Interaction, Synchronicity. Artefact is determined based on individual learning style.

These steps are described below.

An official VARK learning styles model questionnaire[1] was used to diagnose particular learner's preferences. The users can select none or more than one answer to each question, relying on individual perception. Thus, as a result the preferences of learning content format are found.

When a learner is planning the learning process, first (s)he sets the learning objective. The learning method can be selected to achieve this objective. The learning method can be seen as a set of learning activities. Each learning activity can consist of four elements as described in Sub-section 3.1. Each Web 2.0 tool is analysed as a tool consisting of universal functions. *Tool* class is described by using closure axiom (i.e., universal restriction that acts along the property to say that it can only be filled by the specified fillers) due to *Open world assumption in OWL.* These universal functions can consist of four elements as described in Sub-section 3.1.

Interconnections between Web 2.0 tool and learning activity elements are settled as follows:

- LearningActivity and Function.
- Content and Artefact.
- Interaction and Interaction.
- Synchronicity and Synchronicity.

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[1] http://www.vark-learn.com/english/page.asp?p=questionnaire
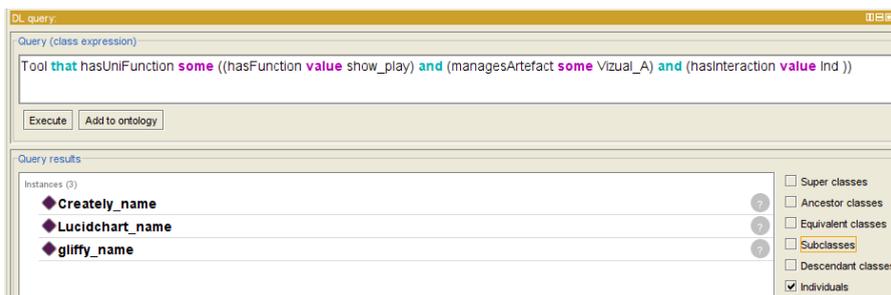
Fig. 3. The example of query.

With the view to select a suitable Web 2.0 tool based on specified elements, the developed ontology was used. Queries could be performed only using a classified ontology. The OWL consistency checker *Pellet* was used for this purpose as well as for ontology *Consistency checking, Concept satisfiability,* and *Realisation* (Sirin *et al.*, 2007).

Also, the *DL query* tab of the *Protégé* ontology editor was used to answer the competency questions. The query language (class expression) supported by this plug-in is based on the Manchester OWL syntax, a user-friendly syntax for OWL DL that is fundamentally based on collecting all the information about a particular class, property or individual into a single construct called a frame. The example of a formalised competency question: "What tool is suitable for a visual learner individually to view the learning content?" in *Protégé 4.3* ontology editor is presented in Fig. 3.

This query in the $\mathcal{SHOIN}^{(D)}$ descriptive language is described as follows:

```
Tool ⊓ ∃hasUniFunction.(hasFunction.{show_play}⊓ ∃managesArtefact.
Vizual_A ⊓ hasInteraction.{Ind})) = {Lucidchart, Creately,
Gliffy}
```

Furthermore, this query could be written as follows:

```
Tool ⊓ ∃hasUniFunction.(hasLearningActivity.{view}⊓
∃managesArtefact.Vizual_A ⊓ hasInteraction.{Ind})) = {Lucidchart,
Creately, Gliffy}
```

Such a variety of question expressions is possible due to the statements equivalence made on the properties (e.g. `hasFunction ≡ hasLearningActivity`) and equality asserted between individuals (e.g. `{show_play} ≡ {view}`) in the developed ontology.

3.3. *Prototype of the Recommender System*

The developed prototype of the knowledge-based recommender system (Fig. 4) implements the method proposed completely.

The system uses the background data before the recommending process begins. These data are in the learner's profile (in DB). The profile has been modelled by creating fixed stereotypes. Thus, the learners (USERS) were attached to a particular category based on the VARK learning styles model.
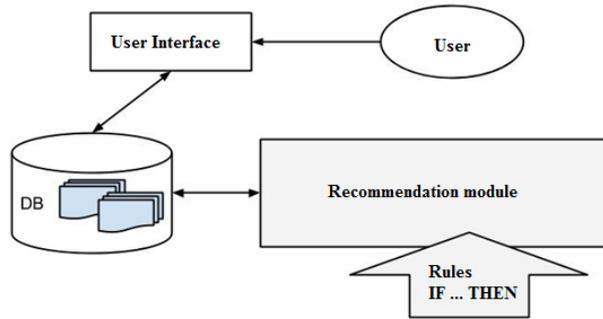
Fig. 4. Scheme of the recommender system.

Also, the user's profiles were represented as sets of weighted keywords. Each keyword refers to the learning style (visual, aural, read/write, kinaesthetic), and the weights (numerical representations) indicate its importance in the profile.

The information needed for the system as input data (trough USER INTERFACE) was provided by a user by selecting the learning objective and the learning method as well as by specifying learning activities, i.e. desirable synchronicity and interaction.

The background and input data were combined and processed by programs (in the RECOMMENDATION MODULE) based on the IF…THEN rules. If all the interconnections between the tool and learning activity elements have been found then the appropriate tool (which has the specified properties) was recommended.

4. Expert Evaluation of Developed System Prototype

The method proposed in Section 3 is aimed to support the learner to achieve the set goals (i.e. to find a suitable Web 2.0 tool for personalised learning) quickly, accurately and completely. With a view to evaluate the quality of the method proposed, it was implemented in the prototype of the recommender system (see Sub-section 3.3). Thus, the problem of evaluation of the quality of the recommender system created arose.

There are several methods to evaluate the quality of software products. (Kurilovas *et al.*, 2014) believe that the main of them are expert centred (so-called top-down), and learner centred (so-called bottom-up). In this paper, the expert centred approach is used.

According to (Oppermann and Reiterer, 1997), expert evaluation methods draw upon expert knowledge to make judgements about the usability of the product for specific end-users and tasks.

Since success of the expert evaluation highly depends on the knowledge and skills of the experts, the following competence requirements for their selection were defined:

- PhD degree in informatics or informatics engineering.
- At least 3 scientific articles published in journals abstracted/indexed in ISI Web of Science database in the fields of informatics, informatics engineering, or education.

- Not less than 10 years-experience in education, and, particularly, in practical use of information and communication technologies in education.

There is a plenty of methods probably suitable to implement for expert evaluating the quality of such alternatives. In the work, the expert evaluation approach is based on MCEQLS (Multiple Criteria Evaluation of the Quality of Learning Software) TFN (Trapezoidal Fuzzy Numbers) method proposed by (Kurilovas and Serikoviene, 2013). In their research, Kurilovas and Serikoviene (2013) argue that their method is applicable in such kind of decision making problems because of its simplicity and efficiency. Differently to (Kurilovas and Serikoviene, 2013), triangular fuzzy numbers were used in the research presented.

A questionnaire consisting of three questions based on the ISO/IEC 25010 quality in use model was prepared for evaluating the system quality. The quality of a system is the degree to which the system satisfies the stated and implied needs of its various stakeholders, and thus provides value. The quality in use is the user's view of the quality of a system, and is measured in terms of the result of using the system (i.e. how people behave and whether they are successful in their tasks), rather than the properties of the system itself. The output can be measured as effectiveness, productivity, and satisfaction of the users (ISO/IEC 25010).

In this work, three criteria were formulated to evaluate the system quality, i.e. (1) accuracy, (2) completeness, and (3) efficiency. The experts used linguistic variables 'bad', 'poor', 'fair', 'good', and 'excellent' to establish ratings (values) of the quality criteria. According to (Kurilovas, Serikoviene, 2014), linguistic variables were converted into average triangle fuzzy numbers as follows: 'excellent' = 0.850; 'good' = 0.675; 'fair' = 0.500; 'poor' = 0.325; and 'bad' = 0.150

The weights of the quality criteria were selected by the experts. After that, based on (Kurilovas and Serikoviene, 2013), the experts' additive utility function (a possible decision transforms a multi-criteria task into one criterion task obtained by adding all the criteria ratings (values) together with their weights) was used, and its final value was 0.814. It means that the system's quality reaches 81.4 % of the quality level in comparison with that of 'ideal' (100%). So, according to the experts, the evaluated system quality is between "good" and excellent".

5. Discussion

In the research presented, several important propositions were defended. They are as follows:

- The knowledge-based recommender system and the domain description in ontology are applicable to personalised learning, i.e. the most appropriate tools, for learner's desirable learning activity performance, can be selected based on his/her learning style.
- The proposed method of integrating Web 2.0 tools in the learning activity allows users to quickly and accurately select the proper tool suitable for learning activity performance.

The main practical importance of the work is that the method proposed could be applied for learning personalisation and, thus, its improvement in general, vocational, and higher education institutions.

The domain knowledge described using OWL language could be used in different recommender systems by providing proposals to personalise learning taking into account not only learning content but also learning activities.

The expert evaluation of the method proposed has shown that the method is applicable in real-life education context, i.e. it is accurate, complete, and efficient in terms of time spent. Thus, educational institutions using the method proposed could achieve better results in terms of learning personalisation, quality, and higher learners' motivation.

The description of Web 2.0 tools by the means of ontology is suitable not only for knowledge-based recommender systems but also for other types of recommender systems that use an item description for recommendations (e.g., content based and community based systems).

6. Conclusions and Results

In the research presented, while analysing Web.2.0 tools, and recommender systems, the following conclusions and results have been obtained:

- In this work, the Web 2.0 classification method that helps a user to learn effectively in the Web 2.0 tools-rich environment has been proposed. With regard to the usage possibilities and managed objects, Web 2.0 tool could be divided into three groups as follows: (1) artefacts management tools, (2) communication tools, and (3) imitation tools. In this way it is possible to group Web 2.0 tools according to their usage possibilities and managed objects, their communication form and sort of imitation process.
- It is proposed to personalise learning according to learner's preferences in terms of learning content and communication modes according VARK learning styles model theory.
- Recommender systems are suitable to personalise learning by proposing the learning tools according to the learner's preferences. Knowledge-based recommender systems propose the elements associating their features with user's features described in the user profile that could be created in the e-learning system according to the learning styles theory. The domain knowledge and user profile used for recommending could be described by ontology, thus enabling knowledge reusability suitable both for human beings and program modules.

The method for Web 2.0 tools integration into the learning activities was created based on the appropriate research and analysis and on recommender systems application to personalise learning as well as the practical experience gained on using these tools. The advantages of the method proposed are as follows:

- It helps to select Web 2.0 tool for learner suitable to implement desirable learning activity according to his/her learning style, i.e. learner's preferences in terms of learning content and collaboration form. Thus, learning process is personalised.

- Its elements are described by the ontology in formal way, and this enables to use domain knowledge in recommender system based on this method.

Prototype of the recommender system based on the method proposed was created.

While performing the expert evaluation of the system prototype based on the method proposed it has been determined that:

- The results provided by the system are accurate – recommended tools are suitable to implement desirable learning activities, i.e. the tools proposed provide a possibility to perform a desirable pedagogical activity in time and to participate in it for a desirable number of learners, and artefacts managed by the tools are suitable for a particular learner according to his/her learning style.
- The system performance is complete and suitable, i.e. it completely corresponds to the method proposed and it operates as it was planned – the system recommends tools in a personalised way.
- Using the created recommender system, it is possible to find Web 2.0 tools suitable for personalising learning quicker than without the system.
- The method and prototype proposed are qualitative with regard to accurateness, completeness and efficiency criteria – the system is 81.4% of the absolute quality.

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Antrosios kartos saityno priemonių rekomendavimas mokymuisi personalizuoti

Anita JUŠKEVIČIENĖ, Eugenijus KURILOVAS

Šio darbo tikslas pristatyti antrosios kartos saityno priemonių naudojimo mokymosi personalizavimui tyrimo rezultatus. Darbe pateiktas personalizuotas antrosios kartos saityno priemonių parinkimo metodas, kai atsižvelgiama į mokymosi tikslus, norimą įgyvendinti mokymosi veiklą, mokymosi turinio pobūdį, bendravimo formas, siekiant padėti besimokančiajam greičiau ir tiksliau rasti tinkamą mokomąją priemonę. Visų pirma, tyrime buvo ištirti personalizuoto el. mokymosi technologiniai ypatumai: rekomendavimo sistemų taikymo personalizuotam mokymuisi galimybės, šių sistemų komponentai. Antra, atlikta antrosios kartos saityno priemonių, tinkamų mokymosi veikloms įgyvendinti, parinkimo metodų analizė. Taip pat buvo sukurtas pasiūlytą metodą realizuojančios sistemos prototipas. Sukurtojo metodo ekspertinis aprobavimas parodė, kad metodas yra taikytinas realiame kontekste: jis yra tinkamas, tikslus ir našus laiko atžvilgiu.