An Ontology based Knowledge Management for a User Preference of E-Learning System

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ABSTRACT

There are many kinds of online electronic courseware services including Google site, Apple's iTunes U, Moodle web-based courseware, and massive open online courses. Knowledge in electronic courseware is widely available but in an unstructured data. Ontology is a good way to manipulate those unstructured data. This paper is aims to understand a user preference in adopting courseware service in an ontology form. An association rule (Data Mining) is applied to find out factors and conditions that lead to decision to choose a service. Due to its benefit to search engine, OWL format is chosen as a file format for this paper. Our experimental results show high percentages of confidence and lift values above 80% and greater than 1 respectively. From the relationship, we construct an ontology for user preference using OWL format. The relationship between ontology knowledge management with user preferences is that knowledge representation represented in Ontology form and then knowledge is organized and acquired via our user preference web-based application.

Keywords: Ontology, user preference, an association rule, data mining, knowledge management.

I INTRODUCTION

In March 2005, the RSU president developed the road map to excellence vision as follows: Competitiveness, E-University, Internationalization, and Certification. All courses are delivered through any high technology device, such as, computer notebook, PDA, smart telephone, the iPhone, the Android-based tablet, and so on. There are many kinds of electronic courseware services in our campus including Google site, Apple's iTunes U, Moodle web-based courseware. Massive open courseware Online (MOOC) is a supplementary by the time this paper published. Table 1 is constructed to compare three services and their available features in 2015. Since MOOC is not in service in our campus yet, it is therefore not in a list of service in Table 1.

All students have rights to consume the knowledge in any kinds of forms. Students can choose any service as a supplementary or main basis on their preference. Each subject can be delivered on many services. One or more services can be adopted simultaneously. A user preference ontology in this paper stand for a preference of choosing a services. Due to many similar kinds of courseware service, we aims to create a user preference for students to guide them a suitable courses service.

Since 2012, every freshmen student gain an iPad tablet for learning tool in university since 2012; therefore, flipped classroom concept can be easily introduced. According to Flipped classroom concept, Students can study at home and come to discuss in class (Abeysekera & Dawson, 2015). Each teacher has been encouraged by university to create e-learning in flipped classroom forms. Student can view some short video before coming to class to discuss. Thanks to the Center of Innovative Learning (CIL), each instructor who needs help on technology will get a consultancy and be guided. Since each teacher/lecture has a different IT literacy, each one chooses something that he/she eases at it. Beside, many massive open online courses (MOOC) are available for anyone around the world.

Knowledge management is concerned with the representation, organization, acquisition, creation, usage, and evolution of knowledge in its many forms. Each university has produced a huge amount of knowledge information in the form of forms. Most of them are either semi-structured data or unstructured data (Ramana, 2002). They are rarely fit into a relational database. Both students and teachers often only use these documents in their daily life. The objectives of this paper are to propose the methodology to capture, create and represent user preference in an ontology form.

In 2015, students at RSU can access many kinds of services. Statistics show that electronics courseware are widely available; therefore, they are not lack of contents. Moreover, there are a lot of features in each service. Some features do not use by most of users. It is hard for new students to learn all features in each service. They also have to learn many new application and tool for acquiring a same knowledge. Due to an overwhelm services, a user preference ontology will help. Factors and conditions that lead to a decision to choose a service would be identified. We aim to create a user preference for students to guide them suitable courses.

II LITERATURE REVIEW

Abeysekera and Dawson (2015) proposed a flipped classroom approaches that an instructor can assign students to study some electronic courseware to teach them key concepts of a particular topic as part of their homework. In the actual lecture the instructor acts as a facilitator to students who engage in a range of problem-solving activities which require them to apply the knowledge they had acquired through the completion of their homework.

Chandrasekaran et al. (1998) proposed that an ontology based knowledge system is modeled to assist engineers in sharing and maintaining knowledge. An ontology provides a mechanism to formally represent a body of knowledge (Chandrasekaran et al., 1998). Knowledge is in many kinds of forms in an unstructured data. Each university has produced a huge amount of knowledge information in the form of lecture notes, home works, e-mails, news, user groups, chats, web-pages, image-files, video-files, and etc. Most of them are either semi-structured data or unstructured data (Ramana, 2002).

Ontology is a good way to manipulate those unstructured data. In recent approaches, ontologies play an important role for knowledge modeling. Chau (2007) proposed that ontologies are one of the key technologies supporting the Semantic Web and the desire to add meaning to the information available on the World Wide Web. Ontology will improve efficiency in knowledge search. Moreover, ontology also supports knowledge sharing and reuse which is a key process in the knowledge management system (Chau, 2007).

III METHODOLOGY

There are three assumptions in this paper as follows. Firstly, students can choose any service as a supplementary or main basis on their preference. Secondly, modern services such as Google site, Apple's iTunes University, Moodle web-based courseware are in widely available services on student preference. Finally, each subject can be delivered on many kinds of services. One or more same kinds of courseware can be adopted simultaneously. To understand a user preference, the objectives of this paper are to propose a methodology to capture, create and represent ontology for user preference. How to develop ontology for a user preference is a goal of this section. Our methodology consists of five steps.

Step 1: Identify list of features
Table 1 shows a comparison of features. It shows that only a few difference between three services.

Table 1. A comparison of features (2015)

Features	Flipped Class Room service		
	Google Site	iTunes	Moddle LMS
1. Mobile support	✓	✓	✓
2. PERFORMANCE MANAGEMENT AND REPORTING (Dash Board)	N/A	N/A	Plug-in Enable
3. Custom Plugin development	N/A	N/A	✓
4. user friendly interface/ Good Theme and Design	✓	✓	
5. Free for users	✓	✓	✓
6. Email support	✓	✓	✓
7. User Profile	✓	✓	✓
8. User Message Notification	✓	✓	✓
9. Collaborative learning (wiki, blogs, forums, Facebook, youtube)	N/A	N/A	✓
10. Locking and Hiding of activity	✓	✓	✓
11. Platform dependence	No	Yes	No
12. Easy setup and maintenance	✓	✓	
13. Grading	✓	✓	✓
14. User attendance and tracking	✓	✓	✓
15. Announcement	✓	✓	✓
16. Assignment	✓	✓	✓
17. Unit Outline/ Learning Guide/ Course Syllabus	✓	✓	✓
18. Lecture Notes	✓	✓	✓
19. Multimedia used in lectures	✓	✓	✓
20. Multiple announcements throughout the semester	✓	✓	✓
21. Group discussion for collaboration	✓	✓	✓
22. Students encouraged to send a mail message to staff if an enquiry of a personal nature	✓	✓	✓
23. A variety of different types of assignment types	✓	N/A	✓
24. Quizzes for assessment purposes (does not include practice quizzes and those that do not have assessment marks)	✓	N/A	✓
25. Grades were released to students for multiple assessments in the majority of sites	✓	✓	✓
26. Tutorial questions and solutions Model assignments (some at a variety of grading levels) Marking criteria and standards Assessment task templates Practice quizzes Past exam papers and solutions	✓	✓	✓
27. Feedback from students	✓	N/A	✓
28. live discussions	Hangouts On Air	N/A	Plug-in Enable
29. Support local language (Thai)	✓	Partial	✓
30. Register/Class check in	✓	N/A	✓

Table 1 shows that a discrepancy features among three services. There are 10 features that are not available to all three service including feature 2, 3, 9, 11, 23, 24, 27, 28, 29, 30 listed in Table 1. Dash board and custom plugin (feature #2 in table 1) do not benefit a normal users. Custom Plugin development feature (feature #3 in Table 1) and class attendance checking (feature #30 in Table 1) are not concerned by user. To simplify a model, we can eliminate all same features and show only a discrepancy features. Therefore, factors that influence a normal user can be reduced into only 7 features shown in Table 2.

Table 2. List of features influential to student (2015)

Features	Flipped Class Room service		
	Google Site	iTunes	Moddle LMS
1. Collaborative learning (wiki, blogs, forums, Facebook, Line)	N/A	N/A	✓
2. A variety of different types of assignment types	✓	N/A	✓
3. Feedback from students	✓	N/A	✓
4. Support Thai language	✓	Partial	✓
5. Platform dependence	No	Only ios device	No (HTML 5)
6. Chat or Live Discussion	Hangouts On Air	N/A	Plug-in Enable
7. user friendly interface/ Good Theme and Design	✓	✓	

Step 2: Applying an association rule to identify factors influencing a decision making in choosing service.

The association rule is to help finding association between feature and adoption. By applying the association rule, the questionnaire aims to find the relationship between 7 features (list in Table 2) and courseware enrollment. Since Feature 6 in Table 2 can benefit to instructor/developer, so we eliminate this feature as it depends on developer and instructor. The obtained relationships will be interpreted by the mined rules which are in the forms of antecedence (LHS) and the consequence (RHS) (Nahar et al., 2013).

$$LHS \rightarrow RHS\ [s,c]$$

where s=support and c=confident (1)

$$Support = P(LHS \cap RHS) \quad (2)$$

$$Confident(LHS \rightarrow RHS) = \frac{P(LHS \cap RHS)}{P(LHS)} \quad (3)$$

$$Lift(LHS \rightarrow RHS) = \frac{P(LHS \cap RHS)}{P(LHS)P(RHS)} \quad (4)$$

Lift ($x \rightarrow y$) measures whether the occurrence of LHS and that of RHS are independent of each other or not. Lift > 1 implies that there are dependency between LHS and RHS. The higher lift, the more meaningful the interpretation of the relationship of LHS and RHS will be (Nahar, 2013).

Step 3. Analyze data

By applying as association rule, Table 3 and 4 reveal their relationship. We divide the confident values into 2 groups including high confident group (shown in Table 4) and medium/low confident group (shown in Table 3). Table 3 shows that these three features do not concerned by students much comparing to three features in Table 4.

Table 3. Medium/Low confident group

LHS			RHS	Conf	Lift	Sup
1. Collaborative learning (wiki, blogs, forums, Facebook, Line)	2. A variety of different types of assignment types	3. Feedback from students	Will students enroll the course?			
Y			Y	0.77	1.49	21%
	Y		Y	0.75	1.46	32%
		Y	Y	0.72	1.43	18%
Y	Y		Y	0.70	1.40	15%
Y		Y	Y	0.72	1.5	11%
	Y	Y	Y	0.75	1.51	19%
Y	Y	Y	Y	0.79	1.59	12%

From Table 4, Feature 4 (support Thai language) is the most influential to student, and followed by Feature 5 (Platform dependence) and then Feature 7 (user friendly interface). Since every freshly student possess iPAD and Apple's ios device is majority OS in the urban area market; therefore, OS platform preference is influential to RSU students.

Table 4. Association rule result

LHS			RHS	Conf	Lift	Sup
4 (Support Thai language)	5 (Platform dependence)	7. user friendly interface/ Good Theme and Design	Enroll course			
Y			Y	0.88	1.75	11%
	Y		Y	0.81	1.61	18%
		Y	Y	0.82	1.64	22%
Y	Y		Y	0.81	1.62	12%
Y		Y	Y	0.80	1.61	22%
	Y	Y	Y	0.81	1.63	13%
Y	Y	Y	Y	0.81	1.62	11%

Factors influencing a decision making in choosing service by Thai students are as follows

1. Preference in supporting Thai language (Partial, Fully Compatible)
2. Preference in OS platform (Apple, Android, Window)
3. Preference in user friendly interface

Step 4: construct an ontology of user preference
Searching results from searched engines can be a long lists of possible answers. Some of them are not relevant to what we are looking for. User preference is added into our system in order to improve a quality of search results. Figure 2 show an overall structure of user preference ontology.

Step 5: Store an ontology into OWL form
A user preference can be varied in each different environment; therefore, it has no certain forms or answers. As shown in Figure 1 and 2, all details cannot store in a regular relational database because of their unstructured data. Ontology form is suitable for an unstructured data. Knowledge management is concerned with the representation, organization, acquisition, creation, usage. In this paper, the relationship between ontology knowledge management with user preferences is that 1. Knowledge representation represent in Ontology form and then 2. Knowledge is organized and acquired via our web application. This file can be used in the knowledge search collaborating with engine in database of information system. It further helps in searching of knowledge from multiple sources such as HTML, documents or databases on the Internet and supports knowledge sharing and knowledge reuse which is the important process in knowledge management. The user preference ontology is stored in the OWL document file as shown in Figure 3. This file can be used in the knowledge search collaborating with engine in database of information system. It further helps in searching of knowledge from multiple sources such as HTML, documents or databases on the Internet and supports knowledge sharing and knowledge reuse which is the important process in knowledge management. The immediate benefit of an ontology based user preference is to search more effectively.

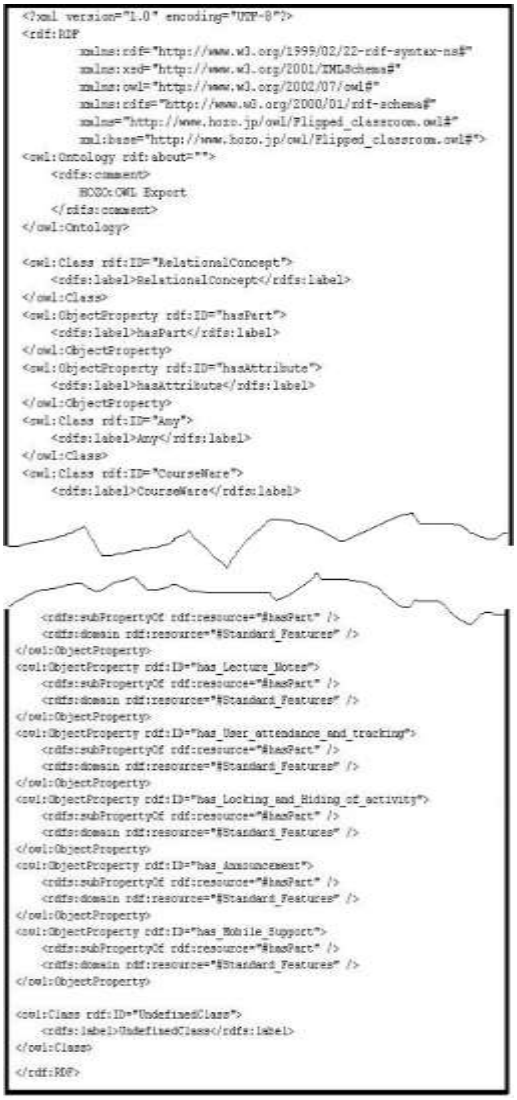

Figure 3. OWL document file

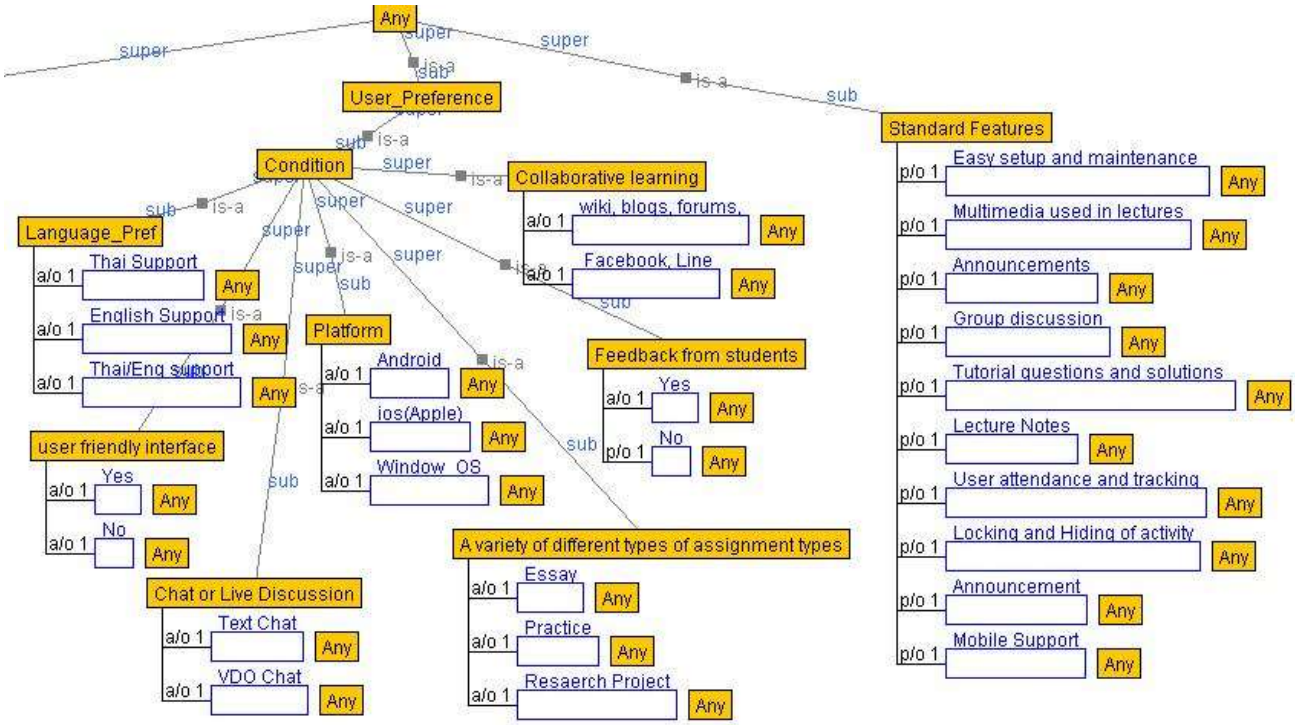

Figure 1. User Preference and Standard Features

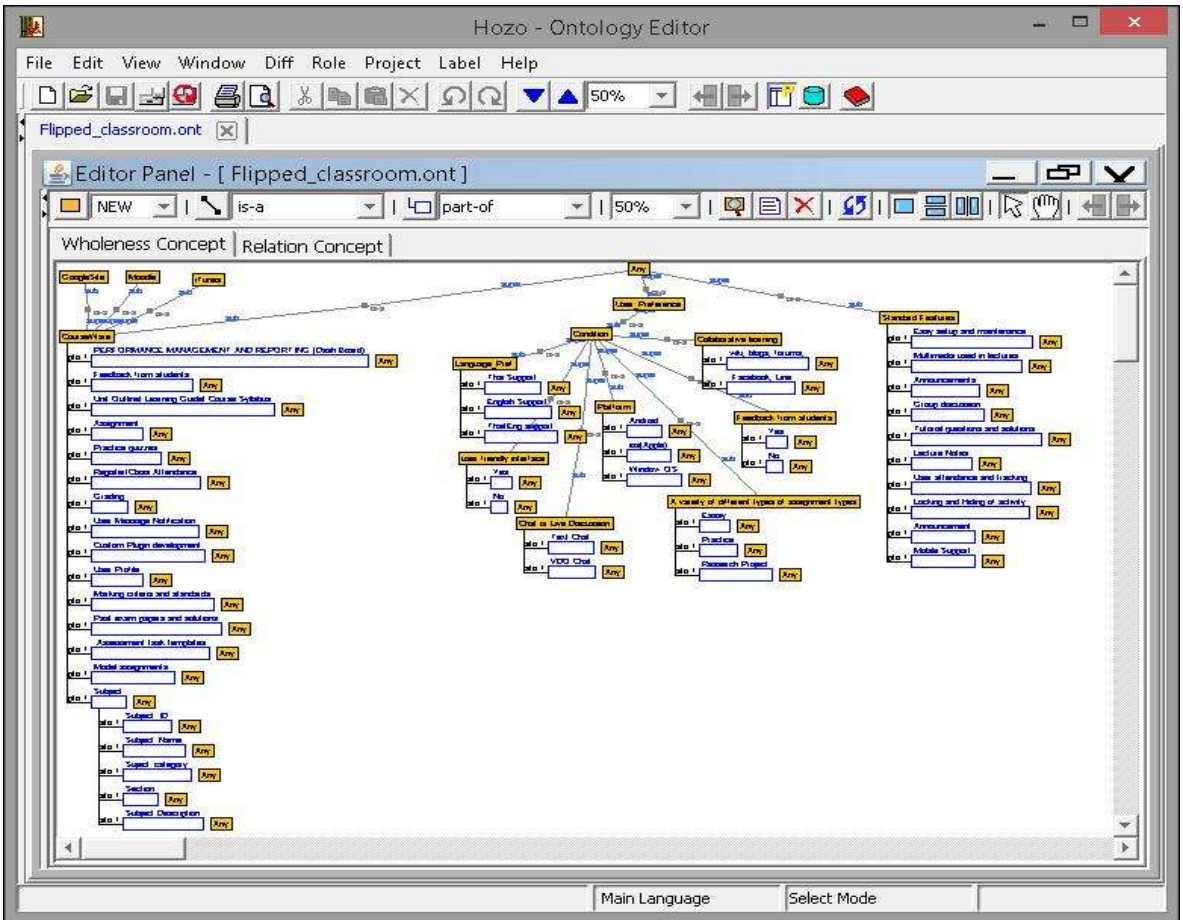

Figure 2. Overall Ontology

IV EXPERIMENT

Questionnaires were distributed to 2500 out of 8000 fleshy Thai students of bachelor, master or Ph.D. student in 2015. After having collected data for 4 months, we get 1,235 user complete questionnaires in total. There are 7 features that are in the questionnaire. All questions in the questionnaire are designed to answer those mined rules. The Apriori algorithm was applied by using WEKA tool with control parameter of Min_Sup=10%, Min_Conf=80% and lift>1.1 (University of Waikato 2015). The experimental result is follows:

Feature4=”Available” → Courseware Enrollment=’Y’ [11%, 0.88]
Feature5=”Available” → Courseware Enrollment=’Y’ [18%, 0.81]
Feature6=”Available” → Courseware Enrollment=’Y’ [22%, 0.82]
Feature4&5=”Available” → Courseware Enrollment=’Y’ [12%, 0.81]
Feature4&6=”Available” → Courseware Enrollment=’Y’ [22%, 0.80]
Feature5&6=”Available” → Courseware Enrollment=’Y’ [13%, 0.81]
Feature4&5&6=”Available” → Courseware Enrollment=’Y’ [11%, 0.81] (5)

Since we set min_conf > 0.8, all results will show all rules that have their confidence values above 0.8. According to an experimental result, it shows that students like to have contents in Thai and they concerns most. Since Lift are all greater than 1 therefore they are highly dependent each other. We can conclude that all three features are influential to students.

Hozo-Ontology Editor is a graphical ontology editor. It was developed by Osaka University, and Enegate Co, Ltd (Mizoguchi, 2007). It can support Resource Description Framework (RDF), Ontology Web Language (OWL), Extensive Markup Language (XML) and a standard of W3C (Mizoguchi, 2007). Ontology will be used for semantic search and knowledge representation with another information system. Moreover, human and the computer can understand. As XML based file, most of search engines are able to read and understand its meaning.

V CONCLUSIONS AND FUTURE WORK

Ontology technology can handle huge amount of unstructured contents like e-learning. It can represent and capture knowledge of user preference better than a relational database. In this paper, a user preference can be varied in each different environment; therefore, it has no certain forms or answers. As shown in Figure 1 and 2, all details cannot store in a regular relational database because of their unstructured data. The immediate benefit of an ontology based user preference is to search more effectively (Inthiran, Alhashmi & Ahmed, 2010). Since there are more than 3000 courses offering each semester, an ontology based user preference is a new good ways to help all students can search for their data. If we can understand student’s needs, we can serve better. An association rule (Data Mining) is applied to find out factors and conditions that lead to decision to choose a service. Due to its benefit to search engine, OWL format is chosen as a file format for this paper. Our experimental results show high percentages of confidence and lift values above 80% and greater than 1 respectively. From those relationships, we can construct an ontology for user preference as OWL format.

An advisor system is viable for students to adopt the courseware (so called services). It is a preliminary step to choose courseware service in universities. Before constructing an advisor system, we need to know user preference. An advisor system will be a future work for next research.

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