Opportunities and Challenges of Using Knowledge Management Systems to Automatically Compile Reusable Learning Objects into Learning Materials

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Abstract. Development of learning materials involves collection of chunks of learning objects that are used to cover the learning objectives specified in the course curriculum. Although the learning objects are available as Open Education Resources in the internet, still the educators can not easily find them unless they posses advanced Information and Communication Technology (ICT) skills. In addition to using advanced ICT skills, the educators must devote a lot of time to search, download and organize the learning objects into efficient learning materials. However in order to make the compilation of learning materials efficient the educators should not be forced to use advanced ICT skills to look for the reusable learning objects. ICT should be used to assist educators to prepare learning materials from reusable learning objects (RLOs) automatically. Knowledge Management Systems (KMS) can be used to search, retrieve and compile the required learning objects into learning material according to the learning objectives. This paper gives an insight on how to automatically compile the learning objects by the use of KMS. The paper will introduce the concept of KMS and describe the related work that has been done to improve the use of KMS in institutions before outlining the challenges and opportunities of using KMS in organizing Reusable Learning Objects

Keywords: Reusable Learning Objects, Knowledge Management Systems, Learning Materials.

1. Introduction

Learning Materials is one of the key elements of the E-Learning Systems. The nature and the flexibility of the learning materials allows E-learning to be delivered to students at their own pace, space and time. Unfortunately most of the Institutions do not have Learning Materials that are catered to serve in the E-learning environment.

Most of the institutions are now trying to increase access to learning materials through Reusable Learning Objects (RLOs) scattered as Open Education Resources (OER) in the internet. RLOs are the basic building blocks of any Learning Materials. Courses and curriculum can be developed from RLOs. They can be as small as a topic in a course or as large as the whole course. They can also be text, visual, audio, video, interactive component, etc[1]. They can be combined to form larger RLOs or divided to form smaller RLOs[2]. Normalizing the definition of "learning objects" would be extremely difficult given the diversity of disciplines, philosophies, and pedagogies in higher education[3]. However for the purpose of this paper we will adopt the definition of Wiley that RLOs are context independent, transportable and reusable pieces of instruction that are digitally managed and delivered[4].

Compiling the Reusable Learning Objects (RLOs) in accordance to the learning materials is not an easy task. Although the RLOs exist as OER, it is still difficult for the educators to find and organise the RLOs since it requires dedication in time and advanced internet search skills. In turn most of the E-Learning Systems up to now do not have well organised learning materials that can be used in E-learning Environment.

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Information and Communication Technology (ICT) can be made intelligent through Knowledge Management Systems (KMS) to search and organise the learning objects into learning materials[5]. According to Lauf et al universities can ensure the right information as well as knowledge gets to the right people at the right time to make the right decisions using KMS [6]. In this case the right information is the reusable learning object, the people are the lecturers and the decision is the learning material. A key principle of KMS is to improve the search mechanisms of information and knowledge[6]. Through KMS, RLOs can be searched, retrieved and organized automatically to produce the learning materials.

2. Literature Review

Knowledge is the information that is understood and assimilated by an individual[6]. Knowledge Management is how people share and manage knowledge. It is the way for linking people, processes and technologies for understanding that people and not system manage knowledge [7]. According to Alavi and Leidner Knowledge Management Systems (KMS) refer to a class of information systems applied to managing organizational processes of knowledge[8]. In education KMS build upon colleague and professional teamwork by actively engaging people in sharing with others what they know and what they learn[7].

KMS organises resources so that computers can understand the information provided by humans using semantic web. KMS is the concepts behind which semantic webs and ontologies work to capture information and knowledge about a subject.[9]. It has been demonstrated that ontologies and semantic web technologies constitute appropriate technologies for knowledge management in educational settings[10]. In the e-learning field, ontologies can be used to model educational domains and to build, organize and update specific learning resources (i.e. learning objects, learner profiles, learning paths, shared repositories etc.)[11]. However, semantic web technologies have not yet been applied widely to deliver learning objects.[12]

KMS help to improve the organisation of application and resources at the user Portals. Using portals, data according to a knowledge domain is programmed into the systems so that the user will be presented with contents that are important to him[13]. The portals are equipped with the knowledge management software that allows the system to track the habits of the user and provide contents that compatible to the user that has logged in it. Portals can be programmed further by KMS and organise the Learning Objects according to the objectives of the educators.

KMS has been used widely in the university setting. Mikulecká in the Czech Republic demonstrates the importance of the KMS in universities and colleges by giving some examples of KMS processes such as student registration, budget allocation, etc. [14]. A roadmap presented by a California based research Institute ,ISKME, gives recommendations to improve knowledge sharing and reform decision-making within university institutions for practical solutions through KMS[7]. Another recent proposal addresses the application of KMS in universities using the ERP (Enterprise Resource Planning) and/or e-learning. An ontology based mechanism for assembling RLOs called OntoGlue uses KMS by enhancing the definition of Learning Objects to include associated knowledge (i.e. requirements and competencies) in their conceptual data schema.[15]

KMS has been very useful in the education domain to make sure that the RLOs are easily available to both learners and the educators. However this can be extended further by building on the intelligence of the KMS to automatically compile the learning materials from the RLOs. Think of a professor sitting in his office with most of the learning objects surrounding him in the books in the shelves and in the computer in the internet. How does the professor collect all those objects into one learning material that will build knowledge to the students?

The key to all these questions lies within the metadata. Metadata is data about data[16]. It is the information describing the RLOs[17]. Metadata usually follow a common rule of annotation and in E-Learning Systems, SCORM [18-20] is an example of the standard of annotating RLOs for their assembly into e-learning contents. However just annotating the RLOs with metadata alone without knowing when and how to annotate will not be enough. Therefore the metadata have to be managed through KMS in order to track who and how to annotate the RLOs.

Using instructional design models, learning materials are built from learning objectives set in the knowledge domain. [21, 22]. The professor just like any other subject experts ought to be familiar with the course at hand and may be capable of defining the learning objectives of the course including Course Rationale, Learning outcomes, Pre-requisite and Assessments. Through Semantic Webs KMS can match the metadata of the reusable learning objects available online with those learning objectives and come up with the series of the learning objects required to be undertaken to complete a particular instructional material. Furthermore through KMS the learning objects can be arranged chronologically to how the course is supposed to be undertaken and provide the user with the necessary tests, tutorials and practices from the internet. This way the KMS would be able to develop the whole course automatically leaving the instructor to provide only the details of course outline which is not a difficult task for any subject expert.

3. Challenges facing the use of knowledge management systems

KMS involves the use of the ICT technologies that are not familiar to many people. It requires ICT experts in the fields of Data Mining and Web Intelligence. Unfortunately most of the institutions do not have these types of ICT experts. Gaeta et al write that "One of the main problems of educational domains modeling is the lacking of expertise in the knowledge engineering field by the e-Learning actors" [11] This means that it will be difficult to develop the KMS for the institution for they will have to rely on the external experts who can most of the time be expensive and not so effective.

Apart from that, KMS involve different users, devices and information systems. The issues of interoperability of the learning materials organized by the KMS have to be considered. It will become difficult for the learning materials designed and developed for one type of device to be interoperable to other devices[23]. It will be hard for someone who is using a mobile phone to access the Learning objects designed for a normal personal computer even though it is organized by the KMS because of the differences of the two devices.[24]

Together with that, there is the issue of the existing E-Learning Information Systems which already house the learning materials for the institutions[25]. KMS has to find ways to reuse the contents from these e-learning systems. This brings the challenge of how the institutions will integrate the existing learning materials in the new KMS without loss of data or destroying the integrity of the learning materials.

Although Learning networks have increased access and sharing of knowledge but they still pose a lot of challenges to the ICT environment.[26] A lot of people access the social media to use and contribute to the resources. But we should not forget those who use the social media to destroy the resources. As the KMS gives room to add up to the metadata defining the reusable learning objects then the contents may be altered which may results in the inefficiency of the learning materials.

There is also the question of how much data the institution can store. As the number and size of the Reusable Learning Objects increases, the amount of data stored in the repositories also increases. This leads to the creation of enormous data that has to be managed in big data warehouse instead of Organizational Data Warehouse. This "logical data warehouse" demands radical realignment of practices and a hybrid architecture of repositories and services.[27].

In order for the KMS to be fully utilized all the stakeholders have to play their roles. The ICT experts, the lecturers, and the management have to play their parts to make sure that the Learning Materials can be accessed and shared easily. Effective knowledge management may require significant changes in culture and values, organizational structures and reward systems[28, 29]. This can only be achieved if everyone in the organization supports the initiatives related to KMS.

4. Opportunities available for using knowledge management systems

With the current developments in the ICT field there exist plenty of opportunities to apply the KMS in automatic creation of learning objects. First and foremost the Reusable Learning Objects are available openly and freely on the internet as Open Education resources (OER). Institutions are slowly embracing the use of Open Education Resources and a lot of organizations are allowing their education repository to be accessed

for free[30]. This makes it possible to create intelligent systems through KMS to capture these reusable learning objects and tailor them to learning materials.

Learning networks brings researchers of similar interest to discuss and share knowledge, expertise and resources regarding various subjects [31]. This means that KMS can get inputs from the learning societies in the development of the Learning Materials. If used well, learning networks can increase the collaboration and the validation of the learning materials through communities of learners and the educators.

Furthermore, the Content Management Systems (CMS) like Digital Open Object Repository (DOOR) allow ICT web technicians to develop intelligent web systems with ease and without using advanced ICT skills[32]. The institutions can customise these CMS into KMS according to the structure of their curriculum. This means it is now possible to develop the KMS easily without using much of the Data Mining and Web Development Skills.

In the long run if the data from the learning materials get too huge to be maintained then Grid computing can be used to improve the access and the sharing of the learning materials. Grid computing allows reusable learning objects to be distributed into a number of areas and that can be accessed as if the RLOs are stored locally within the organization system structure.[33] This way the institutions will be able to access the unlimited amount of RLOs without worrying about how they will store the enormous data created by the learning materials

5. Conclusion and Way Forward

The use of KMS in the design and implementation of the higher learning institutions should be highly encouraged. KMS has the ability to direct the computers to perform most of the e-learning processes of an institution. KMS will reduce the skills and the time spent by the educators to develop learning materials and in turn improve the efficiency of the learning systems. Compiling learning materials is only the beginning of the power of the KMS. A lot of other applications for KMS can be achieved if and when these systems are used well. Therefore the institutions should embrace KMS with open arms to help them not only with increasing the availability of the learning materials but also the access to various other education resources for both the educators and the learners.

6. References

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