A Conceptual Framework for Developing Explorative E-learning Strategy Using Ontology-Based Knowledge Management

Bhavani Sridharan*, Bill Martin, Hepu Deng*

*RMIT University, GPO Box 2476V, Melbourne, Victoria, 3000, Australia

Abstract

This paper presents a conceptual framework for developing explorative e-learning strategy using ontology-based knowledge management. It conducts a comprehensive analysis of the applicability of ontologies in management of knowledge, with a particular reference to the development of explorative e-learning environments for enhancing an efficient use and reuse of available information and knowledge in e-learning, leading to a better understanding of the main issues for developing effective explorative e-learning strategies in an e-learning environment.

Keywords: E-learning; Ontologies; Knowledge management; Learning object metadata

1. Introduction

There have been significant developments in knowledge management, e-learning and ontologies in recent years. Knowledge as an enabler is usually defined as “a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information” (Davenport and Prusak, 1998). E-learning is knowledge intensive and various knowledge management activities namely knowledge dissemination, share, retrieval, and reuse are integral aspects of e-learning for successful transfer of knowledge from the experts to learners. It is well recognised that application of knowledge management techniques can enhance the access to quality learning resources.

Phenomenal shift from the traditional learning setting to e-learning can be noticed since the 1990’s (Gallie and Joubert, 2004). Explorative learning strategy is recognized as one of the key strategies for effective e-learning based on the student-centred constructivist learning theory. In this regard, knowledge retrieval from alternative sources is one of the most crucial and integral aspects of the explorative e-learning process. It enables learners to acquire knowledge from alternative sources. Individual learners, by exploration, reflect their learning, assess their current state of knowledge, accumulate and refine their knowledge, and strengthen their foundation as they become more knowledgeable. Any inconsistencies in the understanding of fundamental theories and concepts are corrected in this way.

There have been notable advancements for supporting learners in their knowledge acquisition processes exemplified by the developments from conventional general purpose search engines to multi-engine search systems. Even though these search mechanisms help in enhancing the coverage and improving retrieval results, some of the problems encountered include information overload, relevancy, quality of context specific results, and so on. To address these shortcomings, the recent developments include development of metadata standards for describing resources on the web and improving the relevancy of information retrieval process. The latest development is in the area of semantic web technology aiming to enhance the relevancy and quality of search results from the resources on the web. Ontologies are the foundation for creating semantic web technology. They play a crucial role in creating semantic relationships between the concepts and learning objects and thereby improving the search results. Despite strident efforts to enable easy and fast access to learning object repositories, each of these studies concentrates on the specific requirement. Not much attention has been paid to manage knowledge in the context of authentic access to alternative learning resources in an explorative e-learning context.

This paper presents a conceptual framework for supporting explorative e-learners in their efforts to finding alternative resources on the web through ontology-based knowledge management. In what
follows, Section 2 presents the research questions and explains several related concepts. Section 3 conducts a review of relevant literature, followed by the development of a conceptual framework for developing explorative e-learning strategy using ontology-based knowledge management.

2. Research Questions

Advancements in information and communication technology have made e-learning a great success with increased intensity of competition among the education providers. Nevertheless, technological developments have proven to be a double edged sword. On one hand, it is a boon to the learning community in terms of enabling swift access to knowledge and information at any time from anywhere. On the other hand, it has augmented the problem of information overload and stalled the timely access to the relevant, context-specific quality information which is always the key to effective learning.

This phenomenon can be attributed to the vast information available on the Internet all over the world with its quick and easy availability within a few mouse clicks. As a result, individual learners often find themselves overloaded with too much information. Continuous updating of web pages only adds to this problem of information explosion on the web. Thus, the creation and distribution of knowledge via Internet on such a phenomenal basis has in fact effectively trapped the learner’s ability to digest and filter the superabundance of information and knowledge. This is particularly true with respect to explorative e-learning scenarios. As a consequence, both researchers and practitioners in e-learning have been working tirelessly in investigating ways for providing and retrieving high relevance and high quality information on a timely basis.

One of the most important issues arising from the technological revolution in e-learning is the optimal use of advanced technology for developing an efficient learning environment. In this regard, several issues warrant further investigation including (a) replication and redundancies of knowledge due to information overload, (b) a lack of transparency and authenticity in knowledge online, and (c) a lack of reuse of valuable knowledge, in particular tacit knowledge, obtained through experience and learning. It is obvious that the development of effective technological tools for facilitating the effective knowledge capture, reuse and distribution within learning communities is highly desirable.

Tremendous efforts have been spent, and significant advances made in developing various information search and retrieval mechanisms for effective e-learning. These developments have improved the performance of search and retrieval mechanisms through the use of semantic metadata, ontology, and semantic web technology. They, however, have not yet been used to their full potential in an educational scenario. A review of existing literature shows that there is a gap in between theory and practice with respect to the application of ontology in an explorative e-learning context embracing knowledge management techniques due to the distributed nature of information and knowledge and the lack of specific authentication and verification mechanisms.

To address this gap, this paper presents a conceptual framework for supporting explorative e-learners in their efforts to finding alternative resources on the web through ontology-based knowledge management. The main research question in this context is: how does one develop a methodology to assist exploratory e-learners in their quest for authenticated, alternative quality learning resources from the Internet to create an effective e-learning environment? More specifically, a number of subsidiary questions can be asked: (a) what are the existing ontology-based strategies and factors to facilitate knowledge requirements of the exploratory e-learners? (b) what are the associated ontology-based tools and techniques in management of knowledge, in particular acquisition, evaluation and dissemination processes? (c) what can be done to improve the existing standards in providing validated quality resources to learners?

In this background this paper explores the potentials of ontologies and associated factors and develops a conceptual framework for an ontology-based knowledge management support to enhance authentic information access to facilitate the development of an effective explorative e-learning environment. This, in combination with semantic web technology may not only provide an effective way to facilitate context specific information gathering processes for individual learners, but it may also help in organization, authentication and verification of the source of the information and knowledge in the interactive learning process. To facilitate the development of such a conceptual framework, a number of key concepts including knowledge management, e-learning, learning object metadata, semantic metadata and ontologies are briefly discussed below.

Knowledge Management is often referred to as “formalisation of experience, knowledge and expertise to create capabilities, to enable superior performance, innovation and enhanced customer value” (Beckman, 1997). E-learning encompasses a learner-centred environment that “integrates technologies to enable opportunities for activities and interaction in both asynchronous and real-time modes with aspects of campus-based delivery and distance education” (Volery
Metadata is defined as “any data which conveys knowledge about an item without requiring examination of the item itself” (Haase, 2004). It has gained its popularity with the invention of the World Wide Web as a technique to facilitate efficient management, discovery, and retrieval of information. Metadata contains structured information about information or learning object. Metadata creation with the formal description of the context, content, and structure of web resources (Marshall et al., 2003) is fundamental to the idea of semantic web. Metadata could be either subjective or objective (Hodgins, 2000). Objective metadata includes factual information such as author, subject, date etc. Subjective metadata includes items such as annotation and keywords, which are very valuable in accessing learning objects. Importance of subjective metadata has been recognized (Hodgins, 2000; Recker and Wiley, 2001), for reuse and context-specific retrieval of learning objects. Semantic metadata is defined as “the process of attaching semantic descriptions to web resources by linking them to a number of classes and properties defined in ontologies” (Scerri et al., 2005). Through the use of ontological structure, semantic metadata has proven to be superior due to its flexibility, human readable and machine processable properties (Al-Khalifa and Davis, 2006).

A learning object is any chunk of learning material, regardless of whether it is a small piece or whole content. Learning objects are sometimes referred to as a document. An important component of learning object is learning object metadata (LOM) (Brase and Nejdl, 2003), or resource profiling (Downes, 2004) to facilitate standardization of learning resources. LOM provides a set of standard elements to describe learning objects in order to enable sharing and reusability of learning resources and facilitate faster access to relevant learning resources. The objective of learning objects is, once created they can be retrieved and reused. Semantic description of learning object through metadata descriptions is the key factor which supports the interoperability and reusability characteristics of LO.

An ontology is a “formal and explicit specification of a shared conceptualization” (Gruber, 1995). In a broader sense, ontology is defined as a conceptualization of a domain into a human-understandable, but machine readable format consisting of entities, attributes, relationships and constraints (Fensel, 2002). Many researchers (Gruber, 1995; Guarino, 1997; Fensel, 2002) have extended this definition to include elements such as the explicit description of concepts in a specific domain and shared understanding. The core characteristic of ontologies is that they enable reusing and sharing of critical knowledge. Ontologies have the potential to facilitate the creation of semantic relationships between various pieces of relevant and useful information, which is the backbone of semantic web, to enhance the learning experience in an e-learning environment. Ontologies can also facilitate provision of consistent vocabulary and word representation for clear communication within knowledge domain. Ontologies have been widely applied in the context of integration and representation of various knowledge resources (Barners-Lee et al., 2001). Machine readable metadata and semantic web are increasingly used to enhance the information retrieval facility.

Ontologies play a major role in knowledge management, e-learning and information retrieval. Various knowledge management activities such as knowledge acquisition, organization, retrieval and reuse are effectively managed through the use of ontologies (Studer et al., 2001; Horrocks and Hendler, 2002). The importance of exploiting the potentials of knowledge management and ontology to augment in effective e-learning is well recognized (Mitri, 2003; Ronchetti and Saini, 2004). The most typical kind of ontology for the Web has a taxonomy and a set of inference rules” (Berners-Lee, Hendler and Laslila, 2001). Apart from the LOM and semantic metadata, annotation (Jovanovic et al., 2006), is considered to be important factor for fostering and enhancing reusability and enabling easily searchable learning objects.

In the recent years there has been a growing interest in the use of ontologies for facilitating fast and quality information retrieval in an e-learning context. Researchers (Gonzala et al., 1998; Staab, 2004; Hatala et al., 2005; Richards and Hatala, 2005; Berri et al., 2006a; 2006b; Mao et al., 2006) propose using semantic relationships between concepts through ontology-based knowledge structure and query expansion, recognising the importance of providing context specific access to information for effective learning. Ontology-based retrieval is expected to perform superior in providing more accurate and comprehensive results due to the context specific semantic nature of the query and clarity in the scope of the query derived from ontology. Also, ontologies facilitate interoperability and thereby enabling effective search results of learning resources (Berri, Benlamri and Atif, 2006b). A focused crawling strategy based on ontologies is suggested (Chakrabarti et al., 1999; Maedche et al., 2002) for improving the query based results from the information retrieval systems. Considering more and more e-learning resources are decentralized and not effectively reused, an ontology-based tool suite namely Courseware Watchdog (Tane et al., 2004) is suggested for supporting learners in finding and organizing learning objects through semantic web. Ontology-based description of learning objects facilitates software
agents to search from not only distributed sources in the web but also heterogeneous sources (Keleberda et al., 2006). Berri (2006) proposes ontology-based framework for accessing learning resources distributed over the web by taking into account the technical environmental constraints of a mobile learner. Topic maps for learning (TM4L) (Wang et al., 2007) is an ontology-based e-learning repositories based on topic maps for managing learning resources.

Other noteworthy developments in use of ontologies to handle the interoperability issue and access to learning resources on the internet in e-learning context include initiatives by National Science Digital Library Project (www.nsdl.org), IMS Digital Repository Interoperability Group, eduSource Project (www.edusource.ca) in Canada, Smart Spaces for Learning (Simon et al., 2003), and the Open Knowledge Initiative (www.mit.edu/oki).

Technologies for ontologies include XML (extensible mark-up language), RDF (Resource Description Framework) and OWL (Ontology Web Language). These three technologies are widely accepted standards for semantic web for structuring information and building ontologies (Berners-Lee, Hendler and Lassila, 2001; Hendler, 2001). Some of the software tools available for building ontologies include OntoEdit and Protégé 2000 which has a GUI and follows the standards of ontology representation in Semantic Web.

Despite advancements in technology to facilitate e-learning, there is only a limited support in reality to satisfy the exploratory learning requirement of learners. Although research and development in the application of ontologies based on semantic relationships between concepts to cater to information needs have advanced, there is a gap in the literature with respect to fine tuning of information access to learners, in terms of management of learning resources in the context of authentic access to alternative learning resources. In this background, the objective of this research is to develop a conceptual framework incorporating the validation aspect and knowledge management techniques in combination with the ontology structure to fill this gap.

3. E-learning, Knowledge Management and Information Retrieval

Support for this research comes from pedagogical theory and learning theory and in particular Papert’s constructionist theories (Papert, 1990). The constructive models of learning that revolves around the learner’s knowledge construction are in agreement with the e-learning philosophy of self-centred and self-guided learning. The constructivist knowledge building process is described as a “cycle of internalization of what is outside, then externalization of what is inside” (Papert, 1990) and is very much pertinent in an e-learning context. The constructivist learning represents a paradigm shift from the traditional teaching approach based on cognitive theories (Bruner, 1960; Vygotsky, 1978). Learning is a process of continuous and active construction and reconstruction of experiences (Dewey, 1938). Technology can pave the way for a constructivist approach to learning and is capable of reforming the current educational pedagogy (Savery and Duffy, 1995; Scardamalia and Bereiter, 1996). The key for constructivist approaches to learning (Bonk and Cunningham, 1998) is to provide access to rich authentic and alternative sources of information.

One of the key strategies for effective e-learning explorative learning is to promote a student-centered learning environment. The learner learns through active exploration by uncovering inconsistencies in understanding and experience (Dalgar, 2001). Meaningful learning requires reflection (Or-Bach, 2005) and learners should have some mechanisms to support this meaningful learning process. Evidence suggests that reflection activities help learners in refining their understanding and reinterpret the previously accumulated knowledge (Or-Bach, 2005). One of the key catalysts for exploratory e-learning strategy is to provide access to alternative resources, through knowledge management processes. Existing literature exhibits semantic knowledge representation (Delteil et al., 2001) and context based approach for knowledge management as an effective technique for accessing information on the Internet (Theodorakis et al., 2002).

Here, it is important to comprehend the relationship between knowledge and information and tacit knowledge and explicit knowledge in a learning context. Learning is described as a progression from data to information and then to knowledge and wisdom, and is a continuum with grey areas overlapping between them (Teo and Gay, 2006). Knowledge “is the capacity to act effectively” and information is “anything that can be digitized” (Dawson, 2000). In a learning environment, the difference between knowledge and information is relative. Mental models and tacit knowledge are transferred to students through dialogue, discussions and lectures. Knowledge is context specific and dynamic and relational (Nonaka et al., 2000) and without reference to context it is just information. Information becomes knowledge in a given context and when cognition takes place. Explicit knowledge becomes tacit when learners internalize information through various means. Both tacit and explicit knowledge complement each other (Nonaka et al, 2000) because, written speech is possible only after the internal thought processes are well developed (Vygotsky, 1978).
The important components of knowledge management are people, content, culture, process and technology (Phillips, 2000). In a learning context, learners and teachers take the role of creating, sharing and re-using knowledge. Content includes context specific, relevant and authenticated knowledge, and information to be shared and managed. A culture of sharing is crucial to the success of knowledge management in a learning environment. Processes include acquisition, organization, authentication and retrieval of knowledge, which are crucial for successful transfer of knowledge for both learners and teachers. Technologies such as communication technology, collaborative technology, artificial intelligence and business intelligence play the role of enabler and facilitator in a learning environment. This will facilitate creation of knowledge repository that is required in a learning environment from various sources. Knowledge management techniques can support many knowledge-building and knowledge conversion processes in the learning environment. Authentication can be achieved through the validation of collected knowledge based on information provided by the experts in the domain area.

Considering that the WWW is the world’s largest knowledge base, it is a challenge to manage such a fast growing resource. Estimation of the size of the web by various researchers (Lawrence and Giles, 1999; Bharat, 2000) comes close to over a billion pages. Delivering relevant learning resources to learners is considered to be an important aspect of exploratory e-learning (Biletskiy et al., 2004) to create an effective learning environment.

Information retrieval tools have become a great boon to filter the exponentially growing information on the web. Since the inception of the Internet in the early 1990’s information retrieval systems or internet search engines have evolved from simple keyword matching, such as world wide worm (McBryan, 1994; Li et al., 2002) to techniques such as personalization of search engines (Fan et al., 2000) via query modification and user’s query mining techniques to improve the precision of the search results. A large body of research exists on the information retrieval system, in particular, multi-engine search services to search information from the web (Etzioni and Weld, 1994; Dreilinger and Howe, 1997; Sugiiura and Etzioni, 2000). These multi-engine search services combine the search results from various search engines and provide it to the user in a consistent uniform interface. It is estimated that the coverage has increased to 42 percent by combining 11 major search engines (Lawrence and Giles, 1999). Improvements include embedding context to the search, and categorization and personalization of the search.

One of the major limitations of keyword based search such as Google, meta-search engine and multi-engine search to knowledge retrieval is the loss of true context of the search, resulting in low precision results as they do not consider relevance or specificity and context of the query. To overcome this limitation many researchers (Haase, 2004; Al-Khalifa and Davis, 2006) propose the use of metadata to enable efficient information retrieval. It has been recognized that searching for resources would be inefficient without metadata information. Metadata is to describe the content, format, and other related elements of an object and to facilitate the information retrieval process. One of the critical aspects of metadata is standardization. To overcome the standardization issue, various metadata standards have been developed for learning objects namely Dublin Core, IEEE LOM (Duval, 2002), IMS Learning resource meta-data, SCORM (Shareable Content Object Reference Model) and Cancore.

Dublin Core (Nejdl, 2002; Brase and Nejdl, 2003) is one of the most well-known vocabularies containing 13 elements such as title, creator, data, publisher, subject etc, to support information retrieval. However, Dublin Core elements do not help much when one looks for a context specific learning environment as it gives very little information about the subject. Also Dublin Core does not include the relevance ranking of retrieved sources. In an e-learning context, IEEE LOM (Duval, 2006) standard is widely accepted due to the flexibility in the standard in terms of extending and adding new data elements. IEEE-LOM has 80 fields arranged in taxonomical structure with categories such as educational, general, annotation and so on.

There is no doubt that these standards have improved the precision rate of search results and enabled retrieval, share and reuse of learning resources. However, these standards are confined to simple structure and are still based on the basic information retrieval technique with term based metadata search and thus, lack of context specific relevant results. As a result researchers (Stojanovic et al., 2001; Huang et al., 2003) have proposed ontology-based semantic web technology to facilitate and enhance management of e-learning resources. Nevertheless, the extent of use of ontology-based knowledge management techniques to assist explorative e-learners in accessing context-specific, quality, authenticated learning resources is limited. In this background, this research is to develop a conceptual framework for providing easy and fast access to context specific quality authentic learning resources through ontology-based knowledge management support.

4. A Conceptual Framework

Proceedings of the 13th Asia Pacific Management Conference, Melbourne, Australia, 2007, 528-538

532
Figure 1 shows a conceptual framework. It is formulated to comprehend the processes in the creation, evaluation and dissemination of an ontology-based learning resource management in an exploratory e-learning context. The framework encompasses four crucial components for effective exploratory e-learning namely the knowledge management, learning, ontology and authentication. The knowledge management aspect includes various knowledge management activities required for provision of alternative learning resources to e-learners. The ontology aspect includes a range of instrumental elements such as LOM, annotation and creation of semantic meta-data ontology structure for enhancing knowledge management activities. Authentication aspect processes the validation part of the approach by using the inference rule and authentication profile knowledge base. Learning aspect includes provision of authenticated resources to learners in forms preferred by learner’s namely navigational resource access and search by query resource access.

The instrumental factors for developing ontology-based knowledge management include annotation of learning objects, semantic metadata in terms relationship between concepts such as prerequisite, part-of, co-requisite to facilitate knowledge acquisition, organisation and dissemination features in an e-learning context. In addition to the above factors, authenticator factor is introduced to enable evaluation, reusability and other aspects of knowledge management and provide access to validated learning objects to learners.

In this framework, the search query in the learner component is gathered either through the keyword-based or through the navigational path and is extended for specificity of the context through ontologies based on semantic metadata. This refined query is processed through the information retrieval system. The learning objects are returned from the web. The returned results are further checked for authenticity and are provided to the learners. The returned result contains just not the link but also annotation, relevancy rating to the query, level of the resource and type of resource and relationship. This additional information will enable the learner to choose the appropriate learning object to investigate without wasting time in exploring the relevant resources.

The ontologies component has two subsets. One is the ontologies structure for a specific domain or a course. Ontologies are created based on the semantic relationship between the concepts such as part-of, prerequisite, is-a, co-requisite and so on. This facilitates refinement of the query, and thereby, includes all the subordinate concepts that a learner is required to learn for getting a strong foundation in the chosen learning object. This in combination with LOM creation based on IEEE LOM standards would help in the query process, as the elements of LOM such as annotation; subject area will enable access to better quality of learning resources. Also some of these elements will be rendered to the learner for choosing appropriate learning resources for dissemination. The ontology layer, on top of the metadata layer, will enable providing extension to the query vocabularies by the links between concepts which would be unrelated in classical search systems. This facilitates retrieval of context specific relevant learning resources and reduces the information overload problem. By adding authentication layer within the ontology structure, the learners can have access not only to relevant learning resources but also authenticated learning resources to build mental models in their learning process. However, in this approach the authentication layer is kept separately for effective knowledge management processes and flexibility for domain experts to validate the resources.

The Authentication component has a rule knowledge base and an authentication profile knowledge base. Authentication profile contains various parameters set by the teacher and the domain expert. This can either be generated manually through a simple interface by the domain expert or semi-automatically generated from the learning objects. The final confirmation, however, has to come from the domain expert for authentication. The rule knowledge base represents a set of authentication rules to validate the learning object. This enables refinement of the results before rendering it to the learner.

The knowledge management component includes various activities such as knowledge acquisition, classification and dissemination activities before storing in the local learning object repository (LLOR). With respect to knowledge acquisition, the authenticated refined results are processed for creation of ontology structure, LOM capture, content capture and terminolog capture with some input from the domain expert. Each of the learning resources is classified based on both the LOM and ontology structure. In this context of knowledge classification, ontologies can play a crucial role for maintenance of LOR and conversion of open resources for reusability purpose. In regards to knowledge dissemination, the retrieved results are stored locally within the course website for both distribution either through ‘push’ or ‘pull’ technology and for reuse. Learners can have access to both navigational view and overall view based on the ontology structure. Reusability of learning objects will be more effective through this approach in exploratory e-learning context.
The knowledge management component includes various activities such as knowledge acquisition, classification and dissemination activities before storing in the local learning object repository (LLOR). With respect to knowledge acquisition, the authenticated refined results are processed for creation of ontology structure, LOM capture, content capture and terminology capture with some input from the domain expert. Each of the learning resources is classified based on both the LOM and ontology structure. In this context of knowledge classification, ontologies can play a crucial role for maintenance of LOR and conversion of open resources for reusability purpose. In regards to knowledge dissemination, the retrieved results are stored locally within the course website for both distribution either through ‘push’ or ‘pull’ technology and for reuse. Learners can have access to both navigational view and overall view based on the ontology structure. Reusability of learning objects will be more effective through this approach in exploratory e-learning context.

The typical scenario is described as follows. Imagine that a learner is in the process of learning a complex case tool namely Oracle designer. In order to develop a model using the tool, the learner needs to learn all the prerequisite and co-requisite, part-of and necessary concepts to have a full understanding of the subject. In this example a small section of ontology is developed for learning Oracle designer is presented in Figure 2.

Assuming that a learner is interested in learning to use Oracle designer to develop a higher order entity relationship model (HERM). To achieve that objective, the learner needs to understand all the prerequisite, co-requisite, part-of, essential part-of concepts as shown in the section of ontology structure in Figure 2. Some of the prerequisite concepts include the basic entity relationship model which in turn requires knowledge on entities, relationships, attributes, key components of attributes such as unique identifiers and foreign keys and the problems with using classical ERM. Essential part-of HERM relationship includes concepts like entities, clusters, first order relationships, higher order relationships, simple attributes, integrity constraints, and so on. Necessary part-of relationship includes ER diagrammer and associated concepts.
As per this framework, the steps involved in providing a context specific learning object are as follows. First the learners query, either through navigational approach or query based approach, is extended based on the semantic relationship between the learning objects in terms of prerequisite, co-requisite, part-of and similar relations based on the ontological structure. Second, LOM in combination with the ontology-based extended query is sent to the standard information retrieval system. Third, the retrieved results are filtered for validation through authentication process. The validated results go through knowledge management process for creation, classification and dissemination of learning resources with ontologies playing critical role in each of the knowledge management activities. Finally identified, authenticated, classified resources are then populated to the local learning object repository collection with LOM details including annotation, relevancy rating in a given course and other required extension elements to facilitate differences in learning levels, styles and types of resources. This framework also proposes facilities to enable learners to populate new learning resources as useful to a particular context, however pending authorization from the domain expert.

Once the local LOR contains comprehensive coverage of authenticated resources, reusability of
authenticated resources becomes possible and students can use the local search agent to search the local learning repository rather than wasting time in searching on the web for validated and relevant materials.

The main contribution of this research is the development of a framework combining knowledge management techniques, authentication schema and ontologies to facilitate a better knowledge exploration and absorption by the learners. First, through the authentication mechanism, the knowledge provided to the users is reliable and correct. This ensures that there is no room for making conceptual mistakes by the learners. Second the query is integrated with the ontologies and LOM to suit the context-specific needs of the learner. Third, through the knowledge management process and use of ontologies enables up-to-date creation and maintenance of learning object repositories, which facilitates future reusability within or outside the course website. Fourth, by extending the metadata to include elements like level, relevancy ranking types of learning object in a given context will cater for differences in levels of learners and type of resources to cater for differences in learning styles. Relevancy ranking should be based on the judgement of the domain expert for a given course rather than on other measures. Fifth, the approach facilitates experts in the field to provide up-to-date authentication profile to take into account the latest developments in a given domain. Last, by integrating the local knowledge base with the global knowledge base, there is a continuous transfer of information explicitly from global to local knowledge base. This enlarges the local knowledge base with every user’s query.

5. Conclusion and Future Work

This paper presents conceptual framework for an ontology-based knowledge management support for provision of access to authenticated learning resources to fulfill the needs of learners in exploratory learning context in higher educational environment. In this framework, use of the instances, properties and relationship between the concepts to modify the term based query is presented using a small section of ontology-based domain example. Authentication process enables filtering of the results and the refined validated context specific result is expected from the outcome.

A pragmatic approach to the problem of information overload is proposed by providing authenticated resources based on the authentication profile, inference rule and context of learning through use of knowledge management techniques and ontologies and associated factors. Ontology based knowledge retrieval in explorative learning context can help in authentication and reusability features. Also the collected repository can be used across for other courses that require some segments of the course due to overlapping of course learning requirements.

Future research in this area includes the identification of other factors as perceived by learners and teachers in developing ontology-based knowledge management support for learners. Also, there is a need to incorporate other learning strategies with this approach and enable other context specific relevant resources readily available for learners in their pursuit of knowledge acquisition. By embedding the learner’s styles and preferences in the approach, the refined and relevant search results tend to be more adaptive to learners requirements. It is also pertinent to identify mechanisms to incorporate automatic updating of learning object repositories in a given domain, checking for outdated links and automatic updating of LOM including annotation and authentication details.

References


Guarino, N. (1997). A commentary to "Using explicit ontologies in
Duval, E. 2006. IEEE standard for learning object metadata
Fan, W., Gordon, M.D. and Pathak, P. (2000). Personalization of
Dawson, R. (2000). Knowledge capabilities as the focus of
organizational development strategy. Journal of Knowledge Management, 4 320-327.
metadat.
Fan, W., Gordon, M.D. and Pathak, P. (2000). Personalization of
search engine services for effective retrieval and knowledge management. In Proceedings of International Conference on Information Systems, Brisbane, Queensland, Australia.
Indexing with wordnet synsets can improve text retrieval In Proceedings of CoNLL-ACL.
Guarino, N. (1997). A commentary to "Using explicit ontologies in
Hodgins, W.H. (ed.) 2000. The future of learning objects, the
instructional use of learning objects, online version.
Huang, W., Tao, T., Hacid, M. and Mille, A. (2003). Facilitate
knowledge communications in multimedia e-learning environments. In Proceedings of MMDB, New Orleans, Louisiana, USA.
Conference on Advanced Learning Technologies, Joensuu, Finland.


