

# How modern Technology in Knowledge Management can support Higher Educational Institutions in modern Learning Settings

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## Abstract:

*In both academic and practically oriented literature as well as on the Internet, knowledge management is used much more frequently with respect to the business world, often in conjunction with "e-business" and "virtual organizations." It has been slow for higher education to adopt knowledge management. There is no doubt that higher education is both scholarly and operationally knowledge rich. Educational institutions are under immense pressure from governments and students to improve their effectiveness and accountability. Given the great importance in the application of knowledge management (KM) in higher education and a lot of activities in organizations, to our best knowledge there are less research and development activities in this application domain within the last few years. In this paper we want to explore how an integrated KM approach and the application of modern technologies are used to support higher educational institutions in modern learning settings.*

## 1 Introduction

Our society at the beginning of the 21st century is characterized by ever-changing economic, political, social and technological situations. Society expects from their members, but also from companies and institutions, to keep pace with these fast changes and to adapt their skills and behaviors in order to be competitive and useful in the global arena. Fast knowledge adoption and sharing, adaptation of organizational structures and procedures but also collaboration without cultural barriers are key aspects to be successful [13, 20, 33]. Over recent years, knowledge management has attracted much attention in both academia and industry. In both academic and practically oriented literature as well as on the Internet, knowledge management is used much more frequently with respect to the business world, often in conjunction with "e-business" and "virtual organizations." Although Knowledge Management (KM) development in the corporate sector has become an increasingly relevant approach in this context, KM has been slow for higher education to adopt knowledge management [11, 29].

Knowledge in an organisation is the collection of expertise, experience, and information that individuals and workgroups use during the execution of their tasks. Organisational knowledge is stored in individual minds, or encoded in organisational processes, services and systems [31]. In knowledge management literature, knowledge is categorized into two broad areas: *explicit knowledge* and *tacit knowledge* [20]. Explicit knowledge is what is written down, codified, expressed in words and numbers (also known as artefacts). Artefacts include reports,

case studies, project plans, procedures, guidelines, best practices, staff data, and strategic analysis. Tacit knowledge, by contrast, is that which can not be easily written down. It is the know-how and learning embedded within the minds of the people in an organisation. It involves perceptions, insights, experiences, skills and competencies. Tacit knowledge is difficult to formalise, difficult to communicate, even more difficult to transfer. It is often something that 'you don't even know that you know'. In reality, these two types of knowledge are inter-related, and are equally relevant for the overall knowledge of an organisation [11].

There is no doubt that higher education is both scholarly and operationally knowledge rich. It can be difficult to identify which knowledge assets are critical to manage. As people change their roles and positions with increasing frequency, knowledge management becomes more important as a means to retain and transfer essential knowledge [29]. Universities, as knowledge intensive organisations, devote billions of dollars each year to research funding for discovery and creation of new knowledge. They employ academics to codify their knowledge in classroom settings and to disseminate their knowledge to students, and they build huge libraries to organize and catalogue the knowledge. Universities communicate knowledge by supporting faculty efforts to write journal articles and textbooks, and sponsoring attendance at conferences in which knowledge is shared between academics and practitioners [18].

Educational institutions are under immense pressure from governments and students to improve their effectiveness and accountability. Within the last decades expectations of higher educational institutions – namely colleges and universities – have undergone dramatic changes from “old, venerable and traditional” institutions to modern, easy accessible institutions which compete and interact even on a global level. Not only the teaching & learning process and the learning platform must meet the requirements of our modern society but also organizational structures and processes must pay proper attention, see for example [33]. Consequently, KM approaches have also been applied in higher education to effectively deal with knowledge, enable innovation, improve customer services, and achieve operational excellence [11].

Given the great importance in the application of KM in higher education and a lot of activities in organizations (see for example [29, 30]), to our best knowledge there are less research and development activities in this application domain within the last few years. This has motivated us to start a research project at Curtin University of Technology in Perth, WA which in particular focuses on the development of enhanced KM approaches and the application of modern technologies to support higher educational institutions in modern learning settings.

In this paper we want to explore how modern technology in knowledge management can support higher educational institutions in modern learning settings. To this end the remainder of the paper is organized as follows: section 2 describes the educational institutions, their challenges and opportunities for improvements of performances and services; section 3 discusses the current knowledge management initiatives in higher education; section 4 proposes an integrated KM approach to address the knowledge management needs in higher education; and in section 5 conclusions and future work are presented.

## **2 Educational Institutions in the 21<sup>st</sup> Century**

Educational institutions have a long tradition in discovering, conserving, refining, transmitting and applying knowledge. They focus according to their objectives to some extent

to teaching and learning, research and development, and services involving different group of people from inside and outside the organization. All of these organizations facing the same problem: dealing effectively with knowledge.

The challenge in knowledge management is to make the right knowledge available to the right people at the right time. Knowledge management has been growing in both corporate and public sector as organisations seek to achieve improved accountability and effectiveness, reduced product development life cycle, increased profitability, and greater customer satisfaction.

Universities have been using information management tools for years to improve the efficiency of administrative services and the effectiveness of academic programs. Historically, the practice of information management within education has focused primarily on the technical systems that are implemented to collect, organise, and disseminate the organisation's quantitative data in such areas as finance, accounting, and enrolment planning, to name just a few [21]. Not surprisingly, those institutions that are investing in technology are finding that technology implementation does not necessarily improve outcomes. Millions of dollars have been put into technology without considering how to effectively integrate those technologies into shared decision-making processes to improve academics, operations, and planning. To facilitate the sharing of information and knowledge, universities have started to look beyond technical capabilities and focus on their overall information environment. In this context, Townley in [29] has defined KM in higher education as *"the set of organizational processes that create and transfer knowledge supporting the attainment of academic and organizational goals"*.

There is no longer a question of whether a university will make information technology an important part of its future. Instead, the questions are: How best to apply these technologies? For what services? Under what administrative structures? How to achieve maximum benefit? For whom? With what tradeoffs? At what cost? Towards finding answers, important aspects influencing and shaping modern educational institutions are outlined in the remainder of this section.

Focusing on the learning process, Burra in [4] suggests an approach that is contextual and timely in the face of changing learner requirements. Ismail in [1] and Gütl in [9] advocate as many others that the learning process must support individual learner profiles which include task and role-based aspects, interests, knowledge state, short-term learning objectives and long-term career goals. Shrivastava in [26] emphasizes another problem in traditional formal education which is the artificial scheduled 60 or 90-minute learning sessions over a semester and that applied learning content is often too static and outdated. He suggested a more natural 'continual anytime anywhere learning approach' where students can learn when they are ready to learn and have need for the knowledge which is continually updating through knowledge instruments and networks. But not only processing and acquiring knowledge is a key to a modern learning approach, but also collaboration and community-based practice for knowledge and skills development are important success factors [4, 25].

By focusing on student characteristics, the traditional image of students has significantly changed. According to Witherspoon in [33], only 20 % fit into the traditional image of an 18-22 student taken courses fulltime. The majority is comprised by part time students as well as employees and citizens, even from other regions and countries, who are selectively enrol courses and participate in programs. Therefore it is important (1) to concentrate on outreach and access to get potential students involved, (2) to make courses and programs comparable

and transferable, and (3) to make it easier for students to transfer their records from institution to institution. Another interesting aspects is that the roles of content creators and content consumer or teachers and students are increasingly blur which is caused by the development and widely adoption of modern ICT based on social software and e-learning 2.0 [1, 23]. Diverse groups of learners require special attention in the learning process and technology in the learning environment must support the different needs; and range from preventing complexity, providing guidance and help but also enable the groups, especially the digital natives the tools of their choice [25, 28].

From the organization point of view, learning must be seen as integrated activities of all stakeholders in higher educational institutions. Learning itself take place over the entire life cycle of the individuals in virtually any part of life, such as educational organizations, business and leisure time [32]. Siemens in [25] further calls for informal instead of structured learning; therefore the environment should be flexible enough which allows learning and discussions activities according to specific needs. Furthermore, learning is not restricted to one learner or a stable pre-defined group. The network of learning agents and sources dynamically changes according to situations and context; it may include individuals, intelligent agents (based on artificial intelligence), communities and organizations such as education institutions, R&D institutions, business and industry, digital libraries, and web resources [5, 6, 22]. Learning is a continuous process which impacts and is impacted by other areas of work and life. As mentioned above, formal education and training programs are artificial constructs in terms of scheduled learning units, but also most settings do not allow to follow up new aspects of this topic or even access the course content after the completion of the course. To overcome this situation, Siemens in [25] calls for more improved and flexible solution. Because of this dynamic and openness, further aspects become important, such as digital rights management, trust building) and security and privacy [14, 25]. From the viewpoint of research and development activities, involved groups of persons demand also support in communication, collaboration, content management in a personalized way, coordination of work and tasks, and community activities [12].

As a result of this section, demands for learning institutions in the 21<sup>st</sup> century are manifold and a sound environment is very complex in term of pedagogical, cognitive, social, organizational and technological aspects as well as influenced by ever-changing environmental situations.

### **3 Knowledge Management Initiatives in Higher Education**

Higher education institutions share a common vision – discovering, developing, preserving and transferring knowledge. Higher education institutions have significant opportunities to apply knowledge management practices to support every part of their mission [11]. Knowledge management in education can be thought of a framework or an approach that enables people within an organisation to develop a set of practices to collect information and share what they know, leading to action that improves services and outcomes. Overall, knowledge management brings together three core organisational resources – stake holders of academic environments, processes, and technologies – to enable the organisation to use and share information more effectively [21]. KM is through a wide range of policies and practices, knowledge management can shape the values of an educational organisation. According to Kidwell in [11], the services and processes that could benefit through KM include (1) the research process, (2) the curriculum development process, teaching and learning processes, (3) student and alumni service, (4) administrative services, and (5) strategic planning. The knowledge management applications recommended include a set of repositories and portals.

This approach is still based on the centralized mentality and suffers the usual problems of keeping outdated information. More importantly, this approach has created a mismatch between the organizational structure and the technological infrastructure.

There have been numerous knowledge management initiatives in higher education. These include building centralised portals (in relation to research, student, etc), modifying library software, adding knowledge management components to student management systems, purchasing intelligence products, enhancing teaching tools, building knowledge management systems, and appointing chief knowledge officers. Such initiatives reported have led to increased student enrolment and satisfaction, improved research team building, and improved student and academic planning. A growing number of universities are managing intellectual property as an asset. It is now widely believed in the higher education sector that knowledge management can help to increase organisational effectiveness through the application of useful knowledge. [29] Majority of existing implementations and research work focuses on centralized solutions and/or addresses very specific aspects. Taken the complex situation in account outlined in the previous section, a more flexible and open approach is required.

## 4 An Integrated KM Approach for Higher Education

The authors in [24] have identified six important components for defining a knowledge management system (KMS), namely: (1) *KMS Architecture*, (2) *KMS Applications*, (3) *KMS Taxonomy and Process*, (4) *KMS Psychology*, (5) *KMS Socio-culture*, and (6) *KMS Audit*. By further focusing on modern technologies supporting KMS, interesting aspects of the components (1) to (3) will be discussed in the remainder of this section.

Given the complexity involved in knowledge management systems, it is believed that architectures have huge impacts on various parameters of systems, such as usability, performance, portability, interoperability, etc. Most KM systems, particularly, in early years, have adopted a centralised architecture [3]. It is widely acknowledged that higher education organizations are highly decentralised in nature. Departments, schools, centres, and other operational units have high level of autonomy to organise and run their operations and programs. Thus a decentralised KM approach is believed to be appropriate for educational institutions. The application of a distributed architecture for KM systems has been extensively discussed by Bonifacio in [3]. The author has argued that architecture for a KM system should be designed to be consistent with the distributed social form in which knowledge is created within organisations. Interesting approaches for distributed architectures include (1) *Service-Oriented Architecture* which can be built by using access to as well as orchestration and choreography of web services and RESTful services, (2) *Intelligent Agents* which reflects the reality that knowledge should be autonomously managed.

From the KMS applications' viewpoint, review of literature shows that researchers often address a single aspect of KM triangle – people, process, and technology. KMS also have been developed in various domains and scale. There are knowledge management systems that address a specific domain, such as skills and competency management, personal knowledge management. Other knowledge management systems attempt to address the institution-wide knowledge management needs. [3] In order to meet the requirements of modern educational institutions, an integrated approach is needed which manages both tacit knowledge and explicit knowledge from inside and outside of the institution. Important services to take into account include data and document repositories, asynchrony and synchrony communication channels, digital libraries, learning content management and learning management systems. Knowledge also is embedded in work processes, and it exists in all core functions of an organization as

well as in its systems and infrastructure. Effective knowledge management programs identify and use also this sort of know-how. On top the above mentioned applications, data and text miners, semantic application but also process management and decision management applications can further enhance the knowledge flow. Strong related to the usage of distributed applications and architectures are security and privacy issues as well as trust aspects [14, 25].

From the taxonomy or more general from the semantic viewpoint, Ontologies are increasingly seen as a key technology for enabling semantic-driven knowledge processing by defining a shared vocabulary in a given domain. A number of ontology-based knowledge management systems have been developed [31]. Ontology is a formal and explicit specification of a shared conceptualisation which can be used for all layers of the KMS. To give some examples, it enables to find services, interpret and merge data, model the education domain (such as research ontology, publication ontology, staff ontology). Furthermore, documents and information in repositories need also to be semantically enriched. Technologies such as classification, (semi-)automatic annotations but also tagging and usage-generated metadata can help to improve the knowledge flow. Furthermore not only artefacts but also persons and group of persons need to be described on a semantic level. In the context of higher education, most knowledge is retained in individuals' heads or personal files and knowledge is the key asset of the university. Faculty, students, and others transform and transfer knowledge resources through teaching, research, publication, service and assessment [29]. By making employee's experiences, knowledge and skills explicit, it is easier to find out what people know or to direct people to others who can be of help. A skills repository can be used to expose skills gaps and competency levels, to enable the search for people with specific skills, and to identify professional development opportunities [19]. Furthermore, analyses of social networks may also help to improve the knowledge flow.

## 5 Conclusions and Future Work

In this paper, knowledge management needs in higher education has been described base on the complex situation of educational institutions of the 21<sup>st</sup> century. Current knowledge management initiatives have been presented. A research framework of an innovative KM approach for higher educational institutions has been established. The approach proposed in this paper attempts to address organisational KM needs based on an integrated approach with the main focus on supportive technology. Future work will involve a prototype development and further research on aspects of KMS Architecture, KMS Applications, and KMS semantics.

### References:

- [1] Alexander, B. (2006) "Web 2.0: A New Wave of Innovation for Teaching and Learning?" Educause, March/April 2006.
- [2] Abecker, A. et al (2003) "Agent Technology for Distributed Organisational Memories – The Frodo Project", Report of German Research Center for Artificial Intelligence (DFKI) – Knowledge Management Department, Germany, 2003.
- [3] Bonifacio, M. et al (2005) "Peer-to-Peer Knowledge Management", Proceedings of I-KNOW'05, Graz, Austria, June 29 – July 1.
- [4] Burra, K (2002) "Beyond the Frontiers of Traditional eLearning", whitepaper, NIIT Ltd, last edited, Feb. 9th, 2002, last retrieved Feb 6th, 2008, from <http://niit.com/Corp/India/ASP/downloads/pdf/Beyond%20the%20frontiers.pdf>

- [5] Cooper, J.E. (2007) 'Strengthening the Case for Community-Based Learning in Teacher Education', *Journal of Teacher Education*, Vol. 58, No. 3, pp. 245-255.
- [6] Dimitrov, V. (2001) 'Learning Ecology for Human and Machine Intelligence', unpublished Web site, last edited 15. July 15th, 2001, last retrieved Jan. 29th, 2008, from <http://www.zulenet.com/see/LearningEcologyHuman.html>
- [7] Firestone, J. M. (2008) "On doing knowledge management", *Knowledge Management Research & Practice* (2008) 6, pp 13-22.
- [8] Guo, Z. and Sheffield, J. (2006) "A Paradigmatic and Methodological Examination of KM Research: 2000 to 2004", *Proceedings of the 39<sup>th</sup> Hawaii International Conference on System Sciences*.
- [9] Gütl, C. (2007) 'Moving Towards a Generic, Service-based Architecture for Flexible Teaching and Learning Activities', in C. Pahl (Ed.) *Architecture Solutions for E-Learning Systems* (peer-reviewed), Peer-reviewed book chapter, Idea Group Inc., Hershey, USA.
- [10] Ismail, J. (2001) 'The design of an e-learning system Beyond the hype', *Internet and Higher Education*, Vo. 4, Issues 3-4, 2001, pp. 329-336
- [11] Kidwell, J.J., Vander Linde, K.M., & Johnson, S.L. (2000) "Applying Corporate Knowledge Management Practices in Higher Education", *EDUCAUSE QUARTERLY*, Number 4 2000.
- [12] Lee, H.L., Kim, J.W., Koh (2008): A contingent approach on knowledge portal design for R&D teams: Relative importance of knowledge portal functionalities. *Expert Systems with Applications*, 2008.
- [13] Li, S. and Chang, W. (2007) "Exploiting and transferring presentational knowledge assets in R&D organisations", *Expert Systems with Applications*, doi:10.1016/j.eswa.2007.10.024.
- [14] Lin, N.H., Korba, L., Yee, G., Shih, T.K., Lin, H.W. (2004) "Security and privacy technologies for distance education applications", in *Proc. of Advanced Information Networking and Applications (AINA 2004)*, pp. 580- 585.
- [15] Lloria, M. B. (2008) "A review of the main approaches to knowledge management", *Knowledge Management Research & Practice* (2008) 6, pp 77-89.
- [16] Mendoza, G. (2005) "Key issues of in the application of knowledge management in education", Master's thesis, Department of Systems and Engineering Management Graduate School of Engineering and Management, Air Force Institute of Technology.
- [17] Mentzas, G. et al (2007) "Knowledge Services on the Semantic Web", *Communications of the ACM*, October 2007/Vol. 50, No. 10, pp. 53-58.
- [18] Mitri, M. (2003) "A knowledge management framework for curriculum assessment", *The Journal of Computer Information Systems*, Vol 43, Iss. 4, pp. 15-30.
- [19] Nussbaumer, A., Gütl, C., and Albert, A. (2007) "Supporting Technology-enhanced Learning through Semi-automatic Detection and Management of Skill and Competence Structures", *ICL 2007, Vilalch, Austria*.
- [20] O'Leary, D. E. (2001) "Knowledge Management Systems: Converting and Connecting", *IEEE Intelligent Systems*, v.13, n.3 (May/Jun), pp. 30-33.
- [21] Petrides, L. A. and Nodine, T. R. (2003) *Knowledge Management in Education: Defining the Landscape*. ISKME Monograph , March 2003.
- [22] Pilotti, L., Sedita, S.R. (2005) 'Human Capital Development in a Complex Learning System: The Virtuous Interaction between Individuals, Organizations and Communities', unpublished Working Paper n. 2005-17, last edited Sep. 2005, last retrieved Jan 30th, 2008, from <http://ssrn.com/abstract=816884>
- [23] Rogers, P.C., Liddle, S.W., Chan, P., Doxey, A., and Isom, A. (2007) "A Web 2.0 Learning Platform: Harnessing Collective Intelligence", *Turkish Online Journal of Distance Education (TOJDE)*, July 2007, Vol. 8, No. 3.

- [24] Rusli, A., Mohd, H.S., Azmi, J., Salfarina, A., and Suaini, S. (2008) “An Empirical Study of Knowledge Management System Implementation in Public Higher Learning Institution”, IJCSNS International Journal of Computer Science and Network Security, Vol. 8, No. 1, January 2008, 281 – 290.
- [25] Siemens, G. (2003) ‘Learning Ecology, Communities, and Networks - Extending the classroom’, elearnspace, last edited Oct. 17th, 2003, last retrieved Feb. 1st, 2008, from [http://www.elearnspace.org/Articles/learning\\_communities.htm](http://www.elearnspace.org/Articles/learning_communities.htm)
- [26] Shrivastava, P. (1998) ‘Knowledge Ecology: Knowledge Ecosystems for Business Education and Training’, unpublished, last edited Jan 1998, last retrieved Feb. 1st, 2008, from <http://www.facstaff.bucknell.edu/shrivast/KnowledgeEcology.html>
- [27] Thitithananon, P., Klaewthanong, T. (2007) “Knowledge Management Is A Perfect Education Development Tool: Is Thailand’s Higher Education Really Ready To Embrace It?”, Journal of Knowledge Management Practice, Vol. 8, No. 2, June 2007.
- [28] Thompson, J. (2007) “Is Education 1.0 Ready for Web 2.0 Students?”, Innovate Journal of Online Education, 2007, Vol. 3, No. 4
- [29] Townley, C.T. (2003) “Will the Academy Learn to Manage Knowledge?”, EDUCAUSE QUARTERLY, Number 2 2003.
- [30] Townley, C.T. (2001) “Knowledge Management and Academic Libraries”, College & Research Libraries, 62(1):44-55.
- [31] Vasconcelos et al (2003) “Organisational Memory Information Systems – An Example of a Group Memory System for the Management of Group Competencies”, Journal of Universal Computer Science, Vol. 9, No. 12, (2003), pp. 1410-1427.
- [32] Wilkinson, D. (2002) “The Intersection of Learning Architecture and Instructional Design in e-Learning”, 2002 ECI Conference on e-Technologies in Engineering Education: Learning Outcomes Providing Future Possibilities, pp. 213-221.
- [33] Witherspoon, J. (2006) “Building the Academic EcoSystem: Implications of E-Learning”, Vol. 3. No. 3, March 2006.
- [34] Wong, S. and Ariguzo, G. (2004) “Knowledge management through the development of information schema”, Information & Management 41(2004), pp 445-456.

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