

# **An exploration in the convergence of knowledge sharing: An e-Humanities application**

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## **ABSTRACT**

In this paper, we present an application of learning environment under Web 2.0 concept and explore a better connection between knowledge management and e-Learning. While ICTs play an important role in facilitating formal and informal learning, an integrated framework is also proposed in the convergence of knowledge sharing and multimedia learning. We also argue that one of the most critical issues for traditional learning, lack of online multimedia instructions, might be solved by exploiting from new forms of interaction and information in the Web 2.0 Age. Our proposed model not only allows for illustrating of real integration and benefits, but also it encourages a new way of thinking about learning applications through innovative ICT collaboration.

## **INTRODUCTION**

To remain competitive, organizations worldwide are continuously investing in training and educational activities, which have played a critical role in their continued success (Westfall 2006). Besides, more and more countries make strong push in e-Learning plans which were integrated all kinds of resources to level up competitive capability. As the Web's impact on traditional educational theories and practices are increasingly apparent, many researches demonstrate with successful case studies of multimedia learning. Technology's far reaching potential has transformed and expanded conventional boundaries of education with a precipitous rise in Web-based applications.

In Taiwan, the Department of Education aggressively planned e-Learning initiative programs in 1994 and built different kinds of experimental platforms to develop e-Learning applications and related technologies suited for Taiwan's environment. After that, the National Science and Technology Program for e-Learning (abbreviated as ELNP) which integrated resources of the industry, government and academic to push Taiwan become Learning Society. Though the ELNP really helps to shape an environment favorable for e-Learning under policy guidance and to stimulate applications development related to e-Learning. However, the status quo of this program gets great praise but poor rating, and most affiliated firms has been operating at a loss for the past several years. The present situation caused due to insufficient multimedia learning instructions, which was pointed by program offices as a most important reason.

Learning is often generally identical to curriculums with some formal activities in a classroom or through web-based way. However, Web 2.0, incorporated different services and technologies, has become distinct from traditional Internet by innovations in business model, in a way of communication and organization. After entering into current phase of Web evolution, a new generation of user-centric, open, dynamic knowledge platform came out. Most learning happens outside of courses in rapidly developing climates where information and knowledge create and change quickly, including online communities, discussion, personal research, reflection, and other network-forming activities. Internet consisted of rapidly growing information repositories which might be logically linked to form a composite or virtual knowledge repository in specific focus domain. With exponential growth of information, Information and Communication Technology (abbreviated as ICT) play an important role in capturing knowledge, storing, indexing and linking digital objects corresponding to knowledge units. We were able to view Internet, with a huge body of knowledge of various kinds around the world, as an information and knowledge dictionary which is preserved, classified, and maintained inside its knowledge space (Fernandes, Raja & Austin 2005).

Current e-Learning efforts continue to put a heavy emphasis on content delivery technology and incorporation of new ICT trends into learning process (Tomei 2008). Researchers have been focusing on how to harness and apply Web 2.0 concepts to create new learning experiences and to learn across communities. E-Learning via Web 2.0 technologies has recently been referred to as E-Learning 2.0 (Downes 2005). In fact, Internet have become a digital knowledge platform which consists of heterogeneous activities, including sharing ideas and comments, collaboratively creating new forms of dynamic learning content, getting effective support, and learning with and from peers.

Many projects and researches are starting to explore how emergent Web2.0 technologies will influence areas of academic and organization learning (Chatti, Klamma, Jarke & Naeve 2007). What is a scenario and model on the utilization and integration of ICTs to promote and improve learning under the Web 2.0 concept? How to solve learning issues in the lack of online multimedia instructions in term of quality and quantity by exploiting from new forms of interaction and knowledge sharing in the Web 2.0 Age? In this paper, we mainly address that a logistic of multimedia e-Learning must rethink in global view and proposed an integrated framework in the convergence of learning, knowledge sharing and ICT. We also explore possible potential of knowledge combination for learning by carrying out case studies of e-Humanities and implementing prototype system.

## **THEORETICAL FOUNDATIONS**

In this section, a linkage of knowledge management and learning is discussed. Then, we conducted several case studies which presented how ICT can be used to enhance combinations of various explicit knowledge for learning purpose.

### **Knowledge Management and Learning**

E-Learning applications has been evolving separately from knowledge management but there have been recent investigations into various integrations of these technologies (Feng, Jeusfeld & Hoppenbrouwers 2004; Marshall, Zhang, Chen, Lally & Shen et al. 2003; Vasilyeva, Pechenizkiy & Puuronen 2005). In past few years, attentions have been shifting towards the importance of knowledge management in corporate and academic learning environments (Lytras, Naeve & Pouloudi 2005; Al-Gharbi & Naqvi 2008). Many best practices focus on searching relevant contents and presenting it with sufficient flexibility to render it meaningful and applicable across multiple contexts of use. The knowledge-creation metaphor of learning views learning as analogous to innovative processes of inquiry where something new is created and initial knowledge is either substantially enriched or significantly transformed during this process (Paavola, Lipponen & Hakkarainen 2004). Researchers try to analyze similarity of methods, technology and some knowledge sharing processes both in knowledge management and e-learning. For example, a work extended a traditional role of digital libraries as information provider to information and knowledge provider. Another experiment constructed a learning framework for knowledge building and collective wisdom advancement in a virtual learning community from the perspectives of system wholeness, learning models, and knowledge management (Gan & Zhu 2007).

Knowledge processing can be segmented into two broad classes: integrative and interactive based on a knowledge management architecture proposed by Zack (1999). However, these conceptually distinct approaches can integrate smoothly through innovative and efficient use of ICT. For example, Amazon's recommendation systems are best known for their use on e-commerce Web sites, where they use information about customers' comments and interests to generate a list of recommended items. For each of the user's purchased and rated items, this software platform and knowledge processing attempts to looking up similar items and recommends them.

ICTs play an important role in operations of knowledge conversion and combination. Now many advance of Web 2.0 applications with more support for collaboration and networking provides new opportunities to overcome many of defects of traditional e-Learning solutions during the process of restructuring and aggregating explicit knowledge into new explicit knowledge. Once knowledge is captured, it becomes explicit knowledge i.e. information that can be stored and accessed. Unlike traditional centralized e-Learning repositories, Web blogs, forums, wikis, archives and databases with user-defined tag

allow quick and wide information dissemination across classroom and organization boundaries. It formed a basis of distributed information repositories with up-to-date, context-rich, and searchable learning assets.

As a consequence, recent researches try to explore how knowledge management models improved and enhanced by Web 2.0 applications in order to support informal learning processes in organizations.

Learning and knowledge management can be viewed as two sides of the same coin and those Web 2.0 concepts and technologies can leverage learning and knowledge sharing (Chatti, Klamma, Jarke & Naeve 2007).

### **Case of Wiki and learning**

Wiki was mentioned by Leuf and Cunningham (2001) as “a freely expandable collection of interlinked webpages, a hypertext system for storing and modifying information – a database, where each page is easily edited by any user with a forms-capable Web browser client”. Besides Wikipedia, best-known encyclopaedia for free-content, many interdisciplinary projects created wikis for their learning activities, such as presenting instructions, problem solving, managing a long-term design process (Parker & Chao 2007). In addition, some universities integrated wikis seamlessly into their main course pages, and took an effective use of wikis for project management, especially for course-related or group projects in particular fields, notably music and languages (Schwartz, Clark, Cossarin & Rudolph 2004).

Wikiversity is a wiki-based learning community. Teachers were able to create course and students can utilize online courses. Not only were learning materials hosted on Wikiversity taken as stand-alone content or as part of a non-Wikiversity course for self-study, it might also act as an initiative for further works on

Wikiversity or other Wikimedia projects, or elsewhere in general. Furthermore, a process of actually learning on Wikiversity is primarily through "learning by doing" or "experiential learning". Editing a wiki is an active, participatory process, involving editing, discussion and reflection. Learning activities on Wikiversity needed to focus on their wiki-based potential and a interaction based on collaborative, communal processes.

### **Application of Ontological Wordnet, Spatio-Temporal Information and learning**

In Taiwan, researchers try to combining different bodies of explicit knowledge into create new explicit knowledge by make good use of ICTs, such as Ontological Wordnet and Spatio-Temporal Information Systems. Sinica BOW (Academia Sinica Bilingual Ontological Wordnet), which integrates three main resources: WordNet, SUMO, and the English-Chinese Translation Equivalents Database (ECTED), provides a basic infrastructure for Ontology studies and cross-disciplinary applications. Sinica BOW is intended as a linguistic infrastructure for and knowledge engineering and many specific researches extended based on it. One of most famous applications was text collections study on classical poetry, such as 300 Tang poems, collection of poems by Su Shi and GuangQunFangPu. (Hsieh, Chang, Huang, Lo & Huang et al. 2006). They not only compare and study the knowledge structure of Chinese historical periods but also gain perspective understanding of the ancient culture and time. These e-Humanities studies combine different resources, including textual, botanic, zoology and artifact information. Their research results not only facilitate genuine cross-lingual access of knowledge but also open to public use, hence knowledge sharing and learning can be bridged simultaneously.

Spatio-Temporal Information Systems (STIS) provide an ability to store, analyze and represent dynamic properties of the information with geographic information in space and time. To foster learning, more and more projects appeal to this technology and it became an emerging research topic. For example, using GIS technology to develop spatio-temporal information platform for historical culture and change of natural environment is a remarkable work. Chinese Civilization in Time and Space (CCTS) and Taiwan History and Culture in Time and Space (THCTS) are among most two famous projects in Taiwan (Fan & Liao 2005).

## **CONCEPTUAL FRAMEWORK**

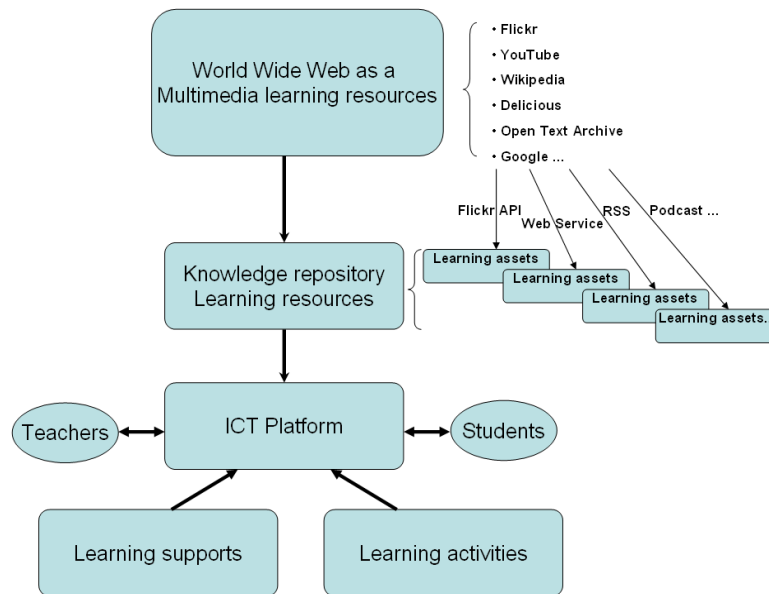
Digital instructions were critical components in E-Learning and had to fulfill international specifications to meet issues of interoperability and reusability. There already existed many learning platforms, however, most commercial software claiming to support E-Learning instruction development not only cost a lot of expense but also required time to get familiar with their operational interface. The quantity and quality of learning instructions still fell behind and it wasn't easy for everybody to achieve their individual goal of learning. In this paper, we try to solve this critical issue by flexible integration of useful information sharing applications.

During past years, e-Learning courses stood on learning management systems and in the browser, and many of them were converted to online versions using auxiliary software. With new trends of web 2.0 and e-Learning 2.0, web-based rapid interactive content for e-Learning are raising their popularity on the ground. Many authors who have fluent skills in Actionscript, JavaScript and HTML were able to publish their teaching instructions or research results for public use and knowledge sharing. The fast development of Internet social networks also help to exchange and communicate useful learning materials between different social network group, such as friends, students, employees, etc. According to the discussion on previous section, knowledge combination occurs when combining different bodies of explicit knowledge into create new explicit knowledge. With trends of Web 2.0, blogs, forums, wikis, archives and databases can be taken as information sources, knowledge repositories and learning assets. By searching and absorbing information easily and quickly, many informal learning materials can be built under the integration of images and video as well as text simultaneously.

## **METHODOLOGY**

More and more online services came out from versatile Web applications, including blogs, forums, wikis, archives and databases. These different bodies of explicit knowledge can be combined and integrated into create new knowledge. Through advanced level of interoperability and extensibility, Web services, RSS (Rich Site Summary) and Podcast made heterogeneous information integration more flexible and powerful.

For example, many radio news website are managed and played using MP3 files and RSS for updates and distribution in efficient way through the Internet. Flickr, famous for photos management and sharing service, has been fuelled by its innovative community tools that allow photos to be marked and browsed by their own keyword metadata (formally called Tag). Because of its support for user-generated tags, Flickr repeatedly has been cited as a paradigmic example of effective use of folksonomy. Besides, wikipedia, which provides definitions and perspectives on the subject being studied, can be considered as learning objects repositories as well. As a result, we propose an integrated framework (illustrated as Figure 1) and process in convergence of knowledge sharing and learning through ICTs in terms of informal learning.



**Figure 1:** Proposed framework

### Framework Components

The schematic of our proposed framework can be illustrated as in Figure 1 and major components of model framework describe as the following:

#### (1) Web as a multimedia learning resource:

With the Internet plays a more and more important role in daily life, many information now publish as Web presentation. Many websites announced as Web 2.0 style are famous for its innovative, interactive and user-friendly design, such as Flickr, YouTube, Wikipedia, Delicious, open text archives and Google, etc. In addition, Web services was key component of new trends in information sharing that different piece of single application is able to be integrated into more complex distributed applications. In this way, the logistic of multimedia Learning resources can be rethinking in global view and take Web as a single platform.

#### (2) Knowledge repository:

The Internet carries various information resources and services which might be taken as learning sources of informal learning. These diverse information and knowledge can be preserved, classified, and maintained as different learning assets, which might be logically linked to form a virtual or composite knowledge repository. Moreover, ICT play an important role in capturing knowledge, storing, indexing and linking these learning assets, including Web Services, Flickr API, RSS, Podcast, etc.

#### (3) ICT helps learning support:

By enhancing learning and teaching methodologies through a use of ICT technologies and encouraging education-centered teaching mechanisms, teachers can benefit from adoption of innovation tools and platforms to carry out related supporting tasks, including news announcement, learning instructions, learning schedules and procedures, learning project management, learning assessment. With innovative uses of ICT to facilitate learning support, students can also access to learning sources widely and easily.

#### (4) ICT helps learning activities:

ICT also facilitate and encourage a process of learning activities in terms of informal learning, such as solving problems, investigations, projects, tasks, role plays, simulation and quizzes, etc. With the

transmission and diffusion of knowledge through experience learning, student can get easy and quick access to ICT-rich teaching and learning resources.

## **EXPERIMENTAL DESIGN**

This research took building auxiliary reference composed of textual, graphical and presentation contents for understanding and learning Chinese celebrity as a research scenario and chose full-text databases for Chinese ancient documents in Academia Sinica, Flickr and SlideShare as research objects to evaluate a feasibility of our model. The former was one of the most important references to study Chinese history and taken as a textual part. Flickr was a so-called best example of Web 2.0 applications and taken as a graphical part. Compared to other websites, Flickr announced APIs of core services publicly for anyone to access and extend functions freely and openly by writing their own clients. SlideShare was a best platform to share and find presentations and you were able to share your presentations publicly or privately.

To test and verify, we cooperated with Sijhih Community University (abbreviated as SCC) in Taiwan and provided a free course base on our proposed framework illustrated as Figure 1. With the goal of providing opportunities of being educated and making knowledge spread set up by community universities, our experiment can be separated into three parts: learning resources preparation phase, learning setting phase and experience learning and feedback phase.

### **Preparation Phase**

Full-text databases for Chinese ancient documents in Academia Sinica shared contents for free access in Taiwan and we took the biography of Confucius in “the Records of the Grand Historian” as text contents. We collected texts contents from Web search interface and converted to learning assets in XML format.

The pictorial learning recourse can be acquired from Flickr by their web service API of search function. By taking Confucius as a tag keyword and searching Flickr databases, we can get many related photos for reference, including the Statue of Confucius, Confucius Temple and birthplace of Confucius, etc. Most query results revealed their close relationship with Confucius and proved high reliability of Folksonomy implicitly as well. Moreover, we applied this sort of logic to SlideShare and taken Confucius as a tag keyword to query. Even though it still return hundreds of presentations, a few of results seems to focus on the Confucius. Most presentation only mentions it as a phrase in the sentence or as an example. However, we still can exploit it as a valuable knowledge repository because the works of SlideShare are always been analyzed, organized and synthesized.

During preparation phase, multimedia resources are processed and transformed to learning assets which are basic elements in knowledge repository through better use of ICTs. Moreover, we develop a prototype system to present available learning resources and as a basis of next phase.

### **Learning setting Phase**

When above multimedia learning material resources were identified and prepared as learning assets, teacher can design informal learning activities for students. By carrying out related supporting tasks through a use of ICT technologies and prototype system, learning news announcement, learning instructions, and learning schedule can present online. Besides, student is capable of accessing multimedia learning assets through advanced way of data integration and information from predefined analysis and transformation process in previous phrase. Our work is to combine the text, image and presentation information into create integrated knowledge about Confucius.

### **Feedback Phase**

The goal of curriculum design from community university's point view is making knowledge spread through students participation. After publishing courses online and setting open for study at their own pace, we also build up a forum for both teachers and students on the purpose of learning discussion. Besides, a

request for filling a questionnaire which was designed and collaborated with SCC to fit our goal of collecting feedback information also sent after a few weeks. Though the results showed that prototype systems still need to improve its user interface design and to offer more function, most agreed its potential to succeed and hope to broaden its scope. By aiming to liberalize the dissemination of knowledge and to offer grown-ups channels to better understand modern society and accomplish life-long adult education, our experiment result got great rating and looked forward to enlarging its learning effect. Our proposed model had encouraged a new way of thinking about dissemination of knowledge and learning.

## **FINDINGS**

Given below is a list of findings from our work.

### **Extensibility Issue**

Since many web 2.0 resources can be transformed as learning assets after processing and transformation. We are able to take advantage of lessons learned from SCORM, a de facto E-learning standard, to improve the practicality and expandability. For example, it can be wrapped into SCORM compatible learning objects with XML metadata. Such arrangement for packaging multimedia learning contents facilitates content delivery and reuse in an efficient and effective way. Besides, content sequencing approaches defined by SCORM can deliver learning activities in a predictable, consistent and instructionally meaningful manner, regardless of delivery environment. Though instructors specify sequencing behaviors at design time, activities are sequenced at time of delivery depending on specified behaviors and learners' actions. Sequencing behaviors are independent from the content to enable greater degree of granularity and reuse.

### **Diversity Issue**

If without critical needs, enthusiasm for learning might lose was a great challenge of modern Web-based learning. To eliminate this kind of concerns and to meet goals of inspiring learners, the implementation must incorporate more information and knowledge resources and take diverse learning methods into consideration. For example, our model can integrate other heterogeneous multimedia information such as videos or flashes within informal learning materials by the same logic. Besides, learning from role play and game-based learning are popular methods for exploring issues and knowledge involved in complex learning situations. In addition, providing personalization and user-defined customization by incorporating different CSS and webpage templates into our framework might help to solve diversity issue and inspire learners properly.

### **Integration Issue**

The primary goal of this research is to provide an unlimited possibility of informal learning framework by integrating different information and knowledge sources under Web 2.0 Era. However, copyright and cognitive load issues are important topics in the integration of various resources and should be taken into account seriously. First, copyright plays a more and more important role over the Internet, take Flickr and SlideShare for example, users can modify their privileges to share publicly or only being visible to friends. Besides, in order to keep flexibility of copyright, users can associate a "Creative Commons" license with photos to satisfy different cases. A license can be divided into several different permissions according to Attribution, NonCommercial, NoDerivs Works and ShareAlike.

Second, based on the dual-channel assumption and limited-capacity assumption, humans possess pictorial and verbal material separately and limitedly (Mayer 2001; Mayer 2003; Paivio 1986). Though we can produce curriculums in unlimited possible by combine different learning assets, cognitive load is a central issue in the design of multimedia instruction according to analysis of some research (Mayer & Moreno 2003). Several theory-based suggestions can reduce cognitive load when producing multimedia

instructions composing of basic assets, including presenting words as narration, placing a text within a graphic or next to elements it is describing are feasible solutions.

### Quality Issue

The multimedia resources can be access automatically and generate learning instructions which will evolve over time, responding to changing circumstances. However, some practical issues should be taken into considerations to accomplish our goal as well. The most important issue is a quality of learning assets. It is a time-consuming and controvertible job and requires doing it carefully under some kind of policy.

Peer-reviewing (Neven & Duval 2002) and ontology are techniques for manual and automatic way to assure quality. However, folksonomy seems to show more available and potential applications than these two methods in nowadays environments and offer more reasonable reference by extracting folks' knowledge. It was a way of user generation, involved and guided to organize information and became a popular phenomenon across the Internet after 2005. A particularity of folksonomy is open, sharable and dynamic refresh (Jun 2006). Through the creation and usage of different tags to make up and search web resources, some tags would fade in and some would fade out. This dynamic refresh often dug out hot trends of information and could be attempted to exploit knowledge for inform learning.

### CONCLUDING REMARKS

This article tries to explore how e-Learning, knowledge management and Web 2.0 concepts converge and to analyze the potential of their cross-disciplinary combination into one integrated framework to facilitate learning. Moreover, we also develop a prototype platform which is composed of available learning resources from full-text databases for Chinese ancient documents in Academia Sinica, Flickr and SlideShare to evaluate a feasibility of our model.

The experiment result got great rating and our proposed model had encouraged a new way of thinking about dissemination of knowledge and learning. How to increase a number of lecturers developing interactive teaching materials for informal learning was a great challenge. This problem can be solved by a fast developing computer-assisted authoring technology and the more willing to share their efforts in a ongoing climate of knowledge sharing.

The goal of keeping everyone informed and involved, learning culture with knowledge sharing can be achieved by ICTs. However, technology alone is not enough. By empowering educational communities with ICT technologies and continuously upgrading their ICT-driven teaching and learning skills is a method worth trying to help build a learning culture. Our proposed framework provides a good best practice for incorporating Internet resources to harness informal learning in organizations.

### REFERENCES

- Al-Gharbi, K. N. & Naqvi, S. J. 2008, "The use of Intranet by Omani organizations in knowledge management", *International Journal of Education and Development using ICT*, vol. 4, no.1.
- Chatti, M. A., Klamma, R., Jarke, M. & Naeve, A. 2007, "The Web 2.0 Driven SECI Model Based Learning Process", *In Proceedings of ICALT 2007*, pp.780-782.
- Downes, S. 2005, "E-learning 2.0", *ACM eLearn Magazine*, available online <http://www.elearnmag.org/subpage.cfm?section=articles&article=29-1>
- Fan, I. C. & Liao, H. M. 2005, "Historical GIS in digital archive and research : the historical GiS of CCTS and THCTS in Academia Sinica", *In Proceedings of The 7th Meeting for the Study of Japanese Military and Colonial Maps*, pp. 16 - 26.
- Gan, Y. & Zhu, Z. 2007, "A Learning Framework for Knowledge Building and Collective Wisdom Advancement in Virtual Learning Communities", *Educational Technology & Society*, vol. 10, no.1, pp. 206–226.

- Feng, L., Jeusfeld, M. A. & Hoppenbrouwers, J. 2004, "Beyond information searching and browsing: acquiring knowledge from digital libraries", *Information Processing and Management*, vol. 41, no.1, pp. 97-120.
- Fernandes, K. J., Raja, V. & Austin, S. 2005, "Portals as a knowledge repository and transfer tool – VIZCon case study", *Technovation*, vol. 25, no.11, pp.1281-1289.
- Hsieh, S. K., Chang, S. M., Huang, C. R., Lo, F. J. & Huang, C. R. et al. 2006, "GuangQunFangPu: e-Humanities Combining Textual and Botanic information", *In Proceedings of the Second IEEE International Conference on e-Science and Grid Computing*, pp. 134-139.
- Jun, M. 2006, "Metadata, Folksonomy and Public Internet", *New Technology of Library and Information Service*, vol. 133, pp. 1-5.
- Leuf, B. & Cunningham, W. 2001, *The Wiki Way: Quick collaboration on the web*, Boston: Addison Wesley.
- Lytras, M., Naeve, A. & Pouloudi, A. 2005, "Knowledge Management as a Reference Theory for E-Learning: A Conceptual and Technological Perspective", *International Journal of Distance Education Technologies*, vol. 3, no.2, pp. 1-12.
- Marshall, B., Zhang, Y., Chen, H., Lally, A. & Shen, R. et al. 2003, "Convergence of Knowledge Management and E-Learning: the GetSmart Experience", *In Proceedings of JCDL'2003, Third ACM / IEEE-CS Joint Conference on Digital Libraries*, pp.135-46.
- Mayer, R. E. 2001, *Multimedia learning*, Cambridge University Press, New York.
- Mayer, R. E. 2003, "The promise of multimedia learning: using the same instructional design methods across different media", *Learning and Instruction*, vol. 13, pp. 125–139.
- Mayer, R. E. & Moreno, R. 2003, "Nine ways to reduce cognitive load in multimedia learning", *Educational Psychologist*, vol. 38, no.1, pp. 43-52.
- Neven, F. & Duval, E. 2002, "Reusable Learning Objects: a Survey of LOM-Based Repositories", *In Proceedings of ACM Multimedia 2002*, pp. 291-294.
- Paavola, S., Lipponen, L. & Hakkarainen, K. 2004, "Models of Innovative Knowledge Communities and Three Metaphors of Learning", *Review of Educational Research*, vol. 74, no.4, pp. 557-576.
- Paivio, A. 1986, *Mental representations: A dual coding approach*, Oxford University Press, Oxford, England.
- Parker, K. R. & Chao, J. T. 2007, "Wiki as a teaching tool", *Interdisciplinary Journal of Knowledge and Learning Objects*, vol. 3, pp. 57-72.
- Schwartz, L., Clark, S., Cossarin, M. & Rudolph, J. 2004, "Educational Wikis: Features and selection criteria", *International Review of Research in Open and Distance Learning*, vol. 5, no.1, pp. 1-6.
- Tomei, L. (edt) 2008, *Adapting information and communication technologies for effective education*, Idea group inc (igi).
- Vasilyeva, E., Pechenizkiy, M. & Puuronen, S. 2005, "Knowledge management challenges in web-based adaptive e-learning systems", *In Proceedings of 5th International Conference on Knowledge Management*, J.UCS in cooperation with Springer, pp.112–119.
- Westfall, J. 2006, "The Impact of Structure on Explicit Knowledge Recall - The Conclusion", *KMPro Journal*, vol. 3, no.2, pp. 28-40.
- Zack, M. H. 1999, "Managing Codified Knowledge", *Sloan Management Review*, vol. 40, no.4, pp. 45-58.