An Interactive Dynamic Model for Integrating Knowledge Management Methods and Knowledge Sharing Technology in a Traditional Classroom

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Abstract

This paper reports an interactive dynamic model using Continuous Knowledge Management methods and Knowledge Sharing technology to integrate the acquisition of skills and relevant information (knowledge level) into diverse, individualized, concurrent learning processes in a traditional classroom setting. As opposed to a passive introduction of technology to facilitate the traditional learning processes a Web based active learning and continuous evaluation process was created which integrates *objective* scientific *knowledge* relating to course content, *subjective knowledge* obtained through personal interactions and *empirical knowledge* collected during the learning process. Knowledge Management, an emerging area of Artificial Intelligence, encompasses identifying, mapping, and managing intellectual assets to generate new knowledge for competitive advantage and for sharing of technology. The Web-based model of knowledge management discussed here allows a diverse group of learners to progressively interact and participate in the learning process, providing non-threatening self-evaluation and just-in-time individualized feedback to the learners and efficient tracking and supervision tools to the instructor. CS1003, a required general education class provides an ideal application of this model as the course draws from a diverse body of students ranging from history to math majors and from freshmen to seniors. The instructional design of this course using the interactive dynamics of Knowledge Management includes (i) provision of course archives and relevant static information as a passive repository, (ii) Web Discussion Forums, electronic chats and email communication for active learning and continuous interaction, (iii) an intelligent self-evaluation and grade reporting system for non-threatening self-testing and what-if analysis of performance, and (iv) a dynamic student feedback system including individualized supervision and anonymous feedback. Application of this instructional process

enhanced the goals of the course from mere computer literacy to what the 1999 NRC Report calls Fluency in Information Technology (FIT). Three kinds of knowledge requirements are identified for FIT: (1) Contemporary skills, (2) Foundational concepts, and (3) Intellectual capabilities. This model is broadly applicable to extend the benefits of traditional classroom instruction to focus diverse intellectual abilities and interests in a collaborative learning process. Formal and informal evaluation support this claim, demonstrating that the transition from purely traditional teaching to a high degree of technology fluency can be painless, efficient and effective in preparing the students for a technology intensive information age.

1 Introduction

In the past few years, delivery of courses using the Internet has become very common in the US. In many cases, the Internet has become a medium of choice for distance education, and in regular lecture classes, course materials are put on the Internet. The Internet is used in many other forms including email, Web searches for information, and Web page postings. Courses in almost all areas can be accessed from sites, such as the World Lecture Hall. (http://www.utexas.edu/world/lecture/). Virtual universities such as Western Governor's University, Phoenix University Online (http://www.uophx.edu/), Walden University (http://www.waldenu.edu/).

Since the Internet is a new medium, there are very few studies to test the effectiveness of teaching online or integrating online teaching with regular face-to-face teaching. Jerald Schuhtte [1] had attracted attention for his 1996 study showing that students in his virtual classroom performed 20% better than his regular class. This study was widely reported, including a piece in *the Chronicle of Higher Education*, Feb. 21, 1997, A23. However, Neal [2] has questioned these results, in particular the research design and methodology of the study. There are reasons to believe that online assessment, simulations, multimedia course delivery, and access to external resources provide potential advantages over lecture-only classes. There are various studies in support of the experimental styles of

teaching and learning. For example, in the learning process, Vygotsky [3] emphasizes that the use of social dialog and interaction are essential ingredients in the learning process. Both of these are an essential part of online courses. Good & Brophy [4] report that Web based testing helps students develop goal setting behavior, planning, and self-monitoring. According to Bloom [5], these provide opportunities for students to master the concepts.

According to Beaudoin [6], the role of the professorate in the new technology intensive environment is going through a rapid change. Not all faculty are opting for integrating technology in to their teaching. Various reasons for this resistance are: fear of losing control over the teaching process, the need to keep technological skills update, fear of change and new technology, and copy right issues. According to Ritchie and Hoffman [7], a well designed course should motivate the learner, specify what is to be learned, prompt the learner to recall and apply previous knowledge, provide new information, offer guidance and feedback, test comprehension, and supply enrichment or remediation.

Traditionally, there are two major models of learning, Objectivist and Constructivist. In the Objectivist model, the teacher controls the mode and pace of learning. Instruction is directed to the whole class as a large group, and the textbook as the primary medium guides decisions about curriculum and instructional design. In the Constructivist model, the instructor acts as a moderator primarily responsible for facilitating learning. Most instruction occurs in small groups, students help choose the content to be organized and learned, and teachers permit students to determine the rules of behavior, classroom rewards, and punishment. The Internet based technology provides discussion groups and text, graphics, audio, video, file transfers over electronic mail, in an asynchronous format. In addition, it offers videoconferencing, whiteboards, and chat in synchronous real time modes, thereby providing a different learning medium that is closely related to the constructivist approach to learning. The use of the Internet and the Web in regular in-class teaching is now becoming universal. However, there is no formal way to integrate and present information using the Web, which is a powerful medium for delivering and structuring course-based information; this medium combined with regular teaching techniques can greatly enhance the learning experience of students.

This paper presents a course structure model to integrate Web technology with knowledge management, an emerging area of artificial intelligence. The model has wide applicability across various disciplines and can be adapted to various settings and styles of teaching. The paper also presents methods and effectiveness of an application of this model to a beginning computer literacy class. A brief background about Knowledge Management (KM) and explanation of why a computer literacy class, CS1003, was used to apply this model follows.

1.1 What is KM? KM is an emerging area of Artificial Intelligence with wide applications in management and industry. Knowledge Management incorporates the triage of knowledge acquisition, its creation, and its transition into the information society. Today, the processes of knowledge acquisition as embodied in undergraduate and graduate teaching, knowledge creation involving both fundamental and applied research, and knowledge transition into society through applications by industry, are institutionally disintegrated. Based on the principles of decomposition of work in the Industrial Age [8], this disciplinary and institutional fragmentation of the pursuit of knowledge is carried over from an earlier age and is less relevant today. Enabled by the power of information technology, American institutions are re-engineering themselves to incorporate end-to-end *process* based thinking, which reunifies decomposed and distributed tasks. The demand for a corresponding re-unification of educational processes is a manifesto of the information revolution in academia.

KM encompasses identifying, mapping, and managing intellectual assets to generate new knowledge for competitive advantage and sharing of technology. The benefits of KM include (1) Rapid Formation of subjective, objective and empirical knowledge, (2) Heterogeneous Knowledge Integration, and (3) Access anytime anywhere conducive to collaborative problem solving.

1.2 Why Use CS 1003 to present this model? Recognizing the importance of Information Technology (IT) and the need to prepare US residents for a technology intensive information age, the National Science Foundation initiated a study in 1997 by the Computer Science and Telecommunications Board (CSTB) of the National Research Council (NRC) to address the subject of information technology literacy. The report [9] of this study identified "literacy" to be too narrow a term, encompassing few of today's computer applications, being static in nature, and lacking "staying power." The committee who wrote the report instead chose the term "Fluency" in Information Technology (FIT) and identified three kinds of knowledge requirements for FIT: (1) Contemporary skills, (2) Foundational concepts, and (3) Intellectual capabilities. Contemporary skills represent abilities to use current computer applications; foundational concepts relate to the how and why of information technology and provide deeper insight into opportunities and limitations of information technology; and intellectual capabilities encapsulate higher-level

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thinking, and the ability to apply the first two components to different applications and to solve unforeseen problems when they arrive. The goal of the NRC report is to make the US citizenry FIT. As a first step, the CSTB committee (of the NRC) chose to focus the implementation of its report on four-year college and university students.

The CS 1003, Computers in Modern Society, is a freshman course and is a university requirement for graduation for all major areas of study at our campus[1]. A typical CS 1003 class consists mostly of freshman and sophomore students, along with some juniors and seniors who have delayed taking this required class. CS 1003 meets the requirements of the focus group identified by the NRC report. Fluency in information technology at the freshman level prepares the students to effectively meet the challenges of a rigorous college program and prepares them effectively for a technologically demanding work place. Traditionally, course content in CS 1003 has stressed: (1) Teaching concepts about computers, and (2) Hard skills, such as using Word Processors (Microsoft Word), Spreadsheets (Excel), Presentation manager (PowerPoint), the Internet and the World Wide Web (referred to as the Web in the rest of the document.) This approach covered the conceptual and contemporary skills requirements of the NRC FIT report, but stressed little of the intellectual capabilities requirements (of the NRC report) that encompass soft skills, such as building research and analytic abilities, problem solving, ability to organize material, writing well, composition, creativity, and thinking.

This report also documents an effort to achieve the NRC report's three knowledge requirements for FIT persons using the KM model proposed in this paper. This effort uses KM techniques, the Internet, the campus local area network, and the PC based lab in a CS 1003 class.

2 A Model for a Course Structure Using KM

The model (hereafter called MCSKM) is as follows. There are five components of KM: (1) Externalization, (2) Internalization, (3) Mediation and Control, (4) Communication, and (5) Cognition. There are three Web based knowledge sharing components (also referred to as knowledge sharing technology): (1) Data Repositories (Web based course material repositories, Online libraries), (2) Medium (Chat systems, Discussion Forums, Email) and (3) Feedback (online grade reporting system, evaluation and examination tools). In the MCSKM model the three components of knowledge sharing technology interact with the five components of KM, and each of these components interact with each other to promote Cognition. The interaction is dynamic and the structure of

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the interactions depends on the focus and goals of a particular subject or a course. The following figure shows the five components of KM, the knowledge sharing technology components, and their interaction. Note that the interaction is achieved through the knowledge sharing technology components. A heuristic to design a course is to first define all the components, both of the KM and of the knowledge sharing technology for the course; then in a diagram similar to the figure given below, work out a relationship between these components by defining teaching or lecture format, course assignments, and modes of interaction with students. Following is a brief explanation of the five KM components followed by an illustrative example.
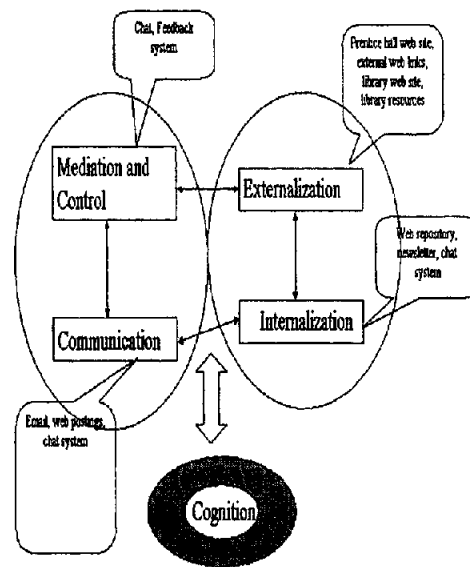

Figure: Components of KM and Knowledge sharing technology in CS 1003

Externalization: This involves availability of course related information in an organized and efficient manner. A set of resources, such as links to web sites, a CS 1003 newsletter, the publisher's web site for the text book, and Internet search tools to capture external knowledge related to the course help externalization. The goal of externalization is to make knowledge available to students through internalization and intermediation.

Internalization: This refers to extracting knowledge to identify what is relevant to a student's work. A repository of course syllabus, assignments, exams, and periodic updates of course relevant information, along with a repository of old answers to exercises would assist with internalization. Exercises that involve writing a research report as a group activity also exemplify this component. Internalization is automated through the technologies of the Web site.

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Mediation and Control: This matches the student (knowledge seeker) with the best sources of knowledge and provides a degree of control for the instructor. In addition to web sources, the students may contact senior students, course archives, and instructor(s). Control involves feedback, learning, and the accumulation of knowledge, for the specific purpose of framing an action. Control and mediation are automated through the technologies of chat system, email, and web based feedback.

Communication: In addition to personal contact, the chat system, email, and a feedback system are means of communication with the students.

Cognition: The goal of the above components is cognition, which relates to the third component *development of intellectual capabilities* of the students as identified in the NRC report. Cognition involves creation or application of knowledge obtained through the previous components and is the ultimate goal of KM in this course. Although few technologies exist to automate this process, integrating the above components with knowledge sharing technology results students to develop communication, thinking, and collaborative problem solving abilities.

3 Application of MCSKM to CS 1003

This model has been applied for three semesters, first by using the learning software components provided by the book publisher, third party vendors, and the campus resources; second by integrating the Internet with regular teaching through a Web site dedicated to CS 1003, and finally for one summer term by using a Web based course management tool Blackboard (Blackboard CourseInfo, available at http://www.courseinfo.com/). The Web site for CS 1003 has the following components:

- An Information Repository. This Web based repository is available anywhere anytime through the Internet. It contains a course syllabus, previous exams, current and past assignments, study tools, resources, and other relevant information.

- A Discussion Forum. This is a web-based forum for CS 1003 designed for online discussion. This forum is available through the campus local area network and the Internet. All discussion topics and replies can be posted from any computer connected through the Internet. Students have posted discussion items for topics ranging from gun control to rising gas prices. This forum also opens the way for CS 1003 students to have discussions with experts from across the country.

- A Student Feedback System. This system provides an online Web based forum where students can give feedback from anywhere and at anytime during the

course. The traditional student evaluation of the faculty is at the end of the course and is of help to the faculty to improve teaching in subsequent classes only. Through this forum students can give feedback anytime during the course. This system has been very successful in improving the content and resources for the class.

- An Online Chat System. An online chat system is available to the class and students use the chat system for group projects and for group learning.

- Email. After about four to six weeks, and after the students' technology skills are enhanced, all submissions of assignments, some grading, and much of the outside class communication are done through email.

- Grade Report System. An interactive system where students can see the grades on the assignments they have submitted and do simple what-if and goal seeking is available online. An example of a what-if analysis is: if instead of making 80% on homework assignment 3, what would be my grade if I made 90%. An example of goal seeking is: if I want to make an overall grade of 90% in the course, how much should I make in the final exam? Students can download from the CS 1003 Web site the grade calculation spreadsheet onto a floppy disk.

There is some KM and some use of technology in every classroom in the US, but usually these efforts are not integrated and are unorganized and informal. The importance and effectiveness of this work lies in successfully formalizing and integrating KM methods and technology components through the five components of KM and the three knowledge sharing components of technology to develop the FITness of students. This FITness is achieved by integrating concepts and skill building through lectures, and then progressively integrating technology and KM methods into regular classroom teaching. The model and the repositories are easily reusable. Based on student feedback, this progressive integration is painless and highly successful in developing intellectual capabilities of the CS 1003 students.

An example group exercise for CS 1003 best illustrates the integration of KM methods with the knowledge sharing technology components.

Assignment *This assignment is one of a group of three assignments that stress collaborative problem solving, writing, and research efforts in a group setting. Each group member should select a topic of interest from the CNN web site at http://www.cnn.com, or a local newspaper (cite the newspaper in your writing,) or select*

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*an item from my recent email to you and summarize the news report or your opinion about the news item in about 100 words. List links to at least three web sites or printed resources that contain related information. On the top of the group assignment write a 200 words overview of what follows; that is, write an introduction to the group member's reports, then combine the writing of each member in a single file under the heading **group report** and send it to me through email.* (Assignment given to fall 1999 CS 1003 class.)

Through this exercise, students perform the five Knowledge Management components using the knowledge sharing technology components. This exercise, by design, uses *Externalization* by making students search the resources like web site, texts, newspaper, magazines, and library resources; *Internalization* by extracting and analyzing relevant information from the above resources; *Mediation and Control* is achieved by students working in groups and having the instructor direct the groups in intermediate stages through a discussion forum, email and chat sessions; *Communication* is achieved by email, personal discussions, and chat rooms; finally *Cognition* is the end product of this exercise. Through this exercise students perform the five Knowledge Management *functions* (components) and use the knowledge sharing technology *components* identified in the KM model implementation for CS 1003. Contrast this exercise with exercises common in a computer literacy class, where students are given automatic steps which perform an operation, such as Internet search or reproducing a text to create a Microsoft Word document.

This model also has general adaptability to different fields of study. In addition, using the methods given in this report, regular teaching may be supplemented by collaborating with area experts from different campuses using Discussion Forums, chat rooms, and email. My students have involved people from different geographic regions, including their old high school teachers, in the Discussion Forums.

4 Evaluation

Our own impression and the feedback from students who have completed the CS 1003 class and faculty who have these students in their classes are very positive. General comments from the faculty are that the students who have taken CS 1003 are better adept in the use of technology and have better research, writing, and analytical abilities, which result in better learning productivity, as compared to students who have not taken this class. In the spring 1998 semester, before the introduction of electronic interaction technology, the students were asked to write a 500 words opinion about "Whether a class can be taught completely through e-mail?" About 83% of the students responded that a course can not be successfully taught

through e-mail, only 9% responded yes it can, and 8% responded yes with reservations, such as every student has to be honest, motivated to read the e-mail etc. At the end of the semester, when the students had been exposed to the online interaction, 68% of the students responded that a class can be certainly taught through e-mail and only 21% were completely opposed to it, and only 11% had some reservations about teaching through e-mail. But 94% of the students in this class found integration of technology with regular teaching to be most beneficial.

Over the past few semesters, after introduction of this model the drop rate for CS 1003 has reduced considerably. According to preliminary estimates, CS 1003 has a 20% drop rate for spring 2000 semester as compared to about 30% for earlier semesters.

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