CAN SIMULATIONS PROVIDE A BETTER EXPERIENCE?
A CAPSTONE APPLICATION

Lahar Patel
University of California, Davis
lpatel@ucd.edu

Taha Sumanna
University of California, Davis
tsumanna@ucd.edu

ABSTRACT

Knowledge in a university is tacit and is partially communicated at the classroom via the interactions among the instructor and the students. As part of an e-learning classroom project, a public university introduced a new technology, a capstone simulation. This simulation facilitates the transmission of the course contents while providing immediate notes for students. In addition, the software enables the university to capture and diffuse via e-mail the class' presentations, group discussions and interactions registered by the instructor. The perceived benefits derived from the use of the simulation in terms of the teaching-learning process and knowledge recovery are evaluated from the point of view of the users. In addition, we discuss the need for a plan to guarantee information maintenance and the establishment of cooperative involvement and trust as critical factors to promote knowledge creation.

INTRODUCTION

Simulations have become a popular tool today to offer better experiences (Chen and Lin, 2009). Simulations today are used to study phenomena in academia (Ben-Zvi, 2010; Chen and Wang, 2010), in business (Dix, 1997; Xi and Yuan, 2010), and in industry (Fang, 2009). We study simulations in the context of knowledge management Knowledge management according to Rosenberg (2001) is "the creation, storing and sharing of value information, expertise and insight within and across communities of people and organizations with similar interests and needs." The concept has been applied for several organizations to take advantage of their personnel experience and individual practices, to increase problem-solving capabilities and ability to make improvements, and to develop an organizational memory (Zhu and Chen, 2005).

Organizational knowledge is considered a highly valued, intangible asset that in the long run becomes a critical factor to sustain competitive advantage (Marr, 2005). Sallis and Jones (2002) point out that among organizations implementing knowledge management (KM), almost none is in the education sector even though universities are clear examples of knowledge organizations where generation and diffusion of knowledge are two of their main value propositions, especially when considering distance learning (Chong and Kasemanandan, 2010; Geller and Smith, 2009). Part of this knowledge is made available to university community and to outsiders via publications of research reports and academic journals, but the work of faculty members is individualistic or involves only a reduced number of partners; therefore knowledge sharing is limited. By using a simulation we can mimic the process of knowledge acquirement. We follow previously published procedures by Po and Deng (2010). Knowledge has been classified into two types (see, Spender, 2002):

a) Explicit knowledge that can be coded or expressed in a formal language and is collected, stored and distributed through documents, technical and research reports, academic journals, monographs, databases, meeting records, or in the case of universities via the syllabus and class notes prepared for professors, and information that could be posted on specialized technological platforms such as Lotus Notes or Blackboard.

b) Tacit knowledge refers to insights, feelings and individual experiences, and it has been described as that type of knowledge which "we know more about it than we can express" (Polanyi, 1966). This type of knowledge is difficult to communicate and is transferred across social interactions among individuals who share a common knowledge base, beliefs, values and experiences. For the university case, these tacit knowledge interchanges could occur for example during faculty meetings and seminars, informal conversations, project collaboration and lectures.

In the academic context effective knowledge management requires not only to collect, organize and store the explicit knowledge in convenient repositories such as libraries, but to use information technologies to assist university members in the identification and search of relevant records and as a mechanism to "extract" additional infor-

mation from the individuals and make it available to the university community (Fang and Chan, 2009; Lei, 2009). Then technology is considered an important resource to capture and share information not only about the research faculty performs or knows about but also to share didactic experiences and teaching materials. Open courseware projects are cited as an example of a knowledge sharing effort in which course syllabi, selected readings and professor's class materials are made available on-line not only to MIT students but to anyone (Santo, 2005). Other uses of technology for education can be found in Chang (2010) and Myburgh and Smith (2009).

From a pure information technology perspective the use of technology solves KM problems because it facilitates knowledge codification and standardization, knowledge sharing and retrieval of best practices and know-how. For example information visualization software makes easier to find information, to graphically describe the amount of information covering different topics available to the user, and to "cross" databases to identify relationships between multiple discipline domains. As another example, the use of Data mining software contributes to decision making and knowledge data discovery by uncover interesting and non-obvious patterns from huge data bases. However the use of sophisticated technologies does not necessarily result in effective knowledge management due to the influence of social factors. From a social perspective, knowledge management is a continuous social process of creating and sharing among individuals that helps to mine tacit knowledge. Then from a socio-technical or integrated perspective, not only the technology but factors such as the organizational culture, relations based on trust and the disposition of individuals to share information across different levels and functions influence knowledge management. Moreover, the degree of implementation of technologies designed to facilitate KM depends on the interest of individuals to use them for knowledge sharing and continuous interaction using a simulation.

The classroom is a social space where knowledge is generated and shared among students and faculty, part of this knowledge is preserved in student's notes or written materials prepared by the professor, but these are ineffective mechanisms of knowledge storage and diffusion to the university community. As part of an e-learning project, the university decided to introduce a new educational technology. This technology does not only facilitate the teaching-learning process but also allows the recovery of part of the tacit knowledge built during lectures and professor-students interactions.

The contribution of Information Technology (IT) to education has been recognized to include the following aspects from Leidner and Jarvenpaa (1993) and Chang and Cho (2009): improved interaction facilitated by computers, distribution of information, simultaneous use of analytical tools (specialized software, Internet, instructor's infor-

mation) and elimination of distance barriers. The simulation not only contributes to these aspects but as mentioned before, it is also a supportive technology for knowledge management.

Other merits of IT in education may be found in Sun and Chen (2010). The relationship between IT, simulations and education is examined in Durget and Smith, (2009), Grisham and Smith (2009) and Smith (2010). However, its implementation requires a collaborative knowledge sharing culture that discourages control of information, competition and secrecy (Sallis and Jones, 2002); confidence among professors about how the classroom information will be used; a technology plan that includes a training strategy and database maintenance; and effective codification and distribution schemes for the collected information. In summary, the technology facilitates knowledge management but do not solve cultural problems or motivate professors to share the knowledge considered as an individual asset.

The exploration of these two critical elements (human resources reactions and activities designed to take full advantage of the technology) will permit the revision of the technology implementation plan, to suggest actions to administrate the technology change and to shorten the technology implementation period. For technology administration, cases like this provide the opportunity to gain understanding about the reactions of the technology adopters so barriers for full diffusion could be anticipated and managed in an efficient way. Sometimes, management takes for granted that users will appreciate the advantages of new technology -in this case class planning, better interaction mechanisms with students, and increased commitment of students with their own learning- and be able to integrate the technology with their activities. However, the introduction of any technology requires a careful planning due to the natural opposition to changes in the professional practices. This case recognizes the need for a social perspective to technology introduction and identifies different actors with different interests (economic, knowledge maintenance, teaching, technical implementation), namely the faculty, the academic and administrative staff, and the technicians.

METHODOLOGY

The study design was empirical employing a simulation and was conducted in the context of superior education in Business administration. The study was limited to instructional situations where professor and students meet at the same time and same place, even though the simulation technology introduced has the potential to facilitate long distance education. The unit of study is a particular school of a public university that offers five graduate and four undergraduate programs in Business Administration. Around 148 professors constitute the faculty of the school that provides instruction to approximately 500 graduate and 2,000 undergraduate students. During the summer of 2011,

the school academic and administrative authorities took the decision to introduce the technology in all the classrooms of the school. At the time of the study eight classrooms, all dedicated to graduate courses have been equipped with the technology. The introduction of this technology is part of an e-classroom effort but it has short and long term objectives.

The collection of information covered two university groups: a) the end users of the technology, in this case the instructors of business graduate courses and b) the university authorities in their role of "champions" and administrators of the technology and its benefits. Different information was collected from each group by using different collection methods, description follows.

From a socio-technical perspective, the implementation of the technology and the benefits derived from its use depend on the cognitive preference of the user, her (his) perceptions about technology's utility, its ease of use (Legris and Pierre, 2003), the fit between the technology and the instructional objectives, the prevailing university culture, and the trust perceptions of professors with respect to the use that university authorities will give to the information captured. In particular, it is important to establish if faculty perceives the technology as a control their performance or as an instrument to take appropriation of their intellectual property since the simulation permits to capture their didactic materials and research discussions during class.

To collect information from professors, a structured questionnaire with 13 items in a Likert scale going from 1=totally agree to 7 = totally disagree was elaborated. We studied three different aspects: the perceptions with respect to the contribution to education; the perceptions related to the utility and complexity of the information captured; and the perceptions on university authorities' support for technology implementation. The questionnaire we used was applied during a group session to more than 10 professors who are the instructors of about a third of the graduate courses in the business school and who have been using the simulation for a complete semester. Data were coded, organized and summarized by using statistical software.

KNOWLEDGE CREATION

Knowledge creation is a dynamic process. Deletion of old or irrelevant information is a key issue because someone must decide which information is worthwhile to keep and then suggest the best way to organize and present the selected information. According to Desouza and Awazu (2005), the maintenance of KM systems is one of the main strategic concerns because the system could become unusable and abandoned very quickly. Assignment of responsibilities such as which entity administrates and operates the knowledge data base has an impact on the efficiency of a

knowledge management system. Another key issue is knowledge codification, i.e. how to organize all the captured information in meaningful and exhaustive categories while preserving the context where it was generated. A third critical element is the diffusion aspect that could be active or passive. Active diffusion means sending bulletins, documents or posting electronic pages to distribute the information someone else organized while a reactive diffusion form occurs when information is retrieved upon demand. These critical elements involve decisions and the elaboration of plans by education and knowledge administrators, in this case represented by the university authorities.

The financial, human and technical decisions required to support the knowledge management systems involve different functional areas, then six persons representing administrative, academic and technical university authorities were interviewed during a focus group by using an unstructured guide. These persons play the role of technology leaders and potential knowledge managers and have three core responsibilities: 1) to facilitate knowledge sharing by setting incentives and creating trust among users, 2) to develop projects to effectively distribute knowledge and 3) to maintain a level of performance that assures the attainment of KM goals.

The focus group technique was selected to collect information from university authorities because it was required to get in-deep knowledge about the university's motivations and expectations regarding the technology adoption. The focus group is a group interview moderated by an expert that relies on the contribution of all participants to conduct a discussion about the topic of interest. This qualitative technique requires the previous elaboration of a "question route" that provides the sequence of themes to be discussed during the session. The following issues integrated the question route and were discussed during the session: the objectives, the type of categorization planned to organize the captured knowledge (didactic practices, research discussions with students, new concepts and ideas, etc.); the methods and resources deployed to code and retrieve the collected information; the human resource plan to administrate the technology change and assure faculty cooperation; and the assignment of responsibilities for the maintenance, security and management of the knowledge database, including issues of author rights.

The focus group session progresses around three recurrent stages. The moderator of the group first announces what is going to be the topic of discussion and the particular subjects to be addressed during the session (declaration stage). Then, the moderator invites the participants to focus on a particular subject in the question route and asks participants to express their attitudes about the subject (interrogation phase). A variable time is assigned to each theme and when no additional comments for the subject are expressed by participants, the moderator proceeds to sum-

marize the contributions of participants to assure the theme has been covered and understood completely, reiteration phase (Erosa et al., 2006). The moderator of the group monitors the advance, the duration and the intensity of the discussion of each subject and decides when to move to the next theme or if it is convenient to modify the order of the question route. Then, the moderator plays a critical role for this technique and must be carefully selected. In this case, the focus group was conducted by one of the researches, lasted around two hours, and the incentive provided to participants (incentives are usual in focus groups) was a guide of how to conduct focus group.

The selection of participants is another important issue when using focus groups, the participants must be individuals with the same profile in terms of their attitudes and knowledge about the research topic. In this case, the participants satisfy this criterion because all of them are involved in the administration of the new technology. The group homogeneity guarantees the consistency and allows cross-validating the results.

The information collected was recorded, transcribed and analyzed through a content analysis using as techniques evidence matrices and content maps. These matrices were elaborated by one of the researchers, and then revised and questioned by the other reassure to assure objectivity and completeness.

RESULTS AND DISCUSSION

The positive perception of the simulation as a useful technology tool for education improvement is not only good in average but also individually because none of the professors expressed disagreement with any of the statements in this dimension. The median for the "education tool" dimension is 1.429 meaning at least 50% of the participating faculty perceives the simulation as useful to organize class contents, elaborate presentations, retrieve information, have access to Internet, and keep students attention.

In average, the second best rated aspect was university's actions deployed to manage risk perceptions and to develop technical capabilities. The true mean score for "technical support and risk management" is estimated as 2.897 and the median score is 2.667, this last measure indicates that 50% of participants are in total or partial agreement with the cited activities. However, there is high heterogeneity in the perceptions, as measured by the standard deviation (1.493) and reflected by the length of the second box (graph). Four (21.43%) of the participant professors feel somewhat or totally insecure about their jobs (disagreement ratings of 5 and even 7 with statements), and half of participants (7 professors) express partial disagreement (scores above or equal to 5) with the current university effort to guarantee the intellectual property of the infor-

mation that is going to be captured via the simulation. The best valued item in this dimension is the sufficiency of the workshop organized to provide the technical abilities to the users and the current technical assistance. The majority of the participants (70%) consider they acquire the required technical proficiency thanks to these actions, and only one professor expressed high disagreement (score of 6) with this item.

The last dimension "technology support for knowledge management" has the lowest level of agreement, the true score mean lies between 2.47 and 3.53 reflecting a global indecision with respect to the technology tool supporting knowledge sharing and diffusion of outstanding didactic practices and new information about course contents.

Professors' perceptions are homogenous. One professor totally agreed (score of 1) the simulation is a technology tool for knowledge management while another partially disagrees with this perception (score of 5). Within this dimension, the highest variability in perceptions occurred with the item that questions about the complexity to organize, to code and to access the information captured. The median is 1.00 meaning half of the professors are in total agreement that current knowledge administration program is expressed high or total disagreement. Information was organized across three main categories. The perspective of each functional area: administrative, academic and technical are contrasted along these categories.

During the focus group it was evident that university authorities have not realized the simulation's potential as a knowledge management tool. The technical area recognize this potential but it is not a proper leader because this is a support area, and does not have the authority to encourage professors to share and use the tacit knowledge generated during lectures. The administrative are is interested in the implementation of a knowledge management system because they recognize the system is an opportunity to improve the productivity and quality of the education in the business school. However administrative authorities do not have any strategy to capture, organize, save and diffuse the knowledge.

The academic authorities, those who have an actual influence over users and could recommend what information is relevant to preserve, visualize the simulation just as an educational tool, a mere substitute of traditional blackboard that allows to retrieve and combine information from multiple sources during class.

The technical area was identified as the technology champion, providing a clear example of "technology push" with a consequent under-use because academic authorities do not recognize the full potential of the technology and they are unsure about the benefits derived from the creation of a knowledge system. Also, faculty and academic authorities are concerned about how to handle intellectual property if the KM system is deployed, and therefore are unwill-

ing to cooperate until this issue is solved.

The focus group discussion showed the need for the integration of the three functional areas to define a strategic plan to get high level benefits and to justify the economic investment. Given the current situation, only the short term objectives are reachable.

De Tienne et al. (2004) propose a model describing four key factors that contribute to effective knowledge management. These factors are: 1) organizational culture that includes cooperation, trust and incentive creation, 2) organizational leadership, 3) the recognition of the Chief Knowledge Office (CKO) and 4) the technology. According to the information collected from faculty and university authorities it is concluded that only the technology factor was considered in this case, and even this factor was sub-estimated in its value. Both university's authorities and faculty consider the simulation only as a complementary and up-to-date educational tool with the potential to improve lectures, facilitate class discussion and preparation, and give the students the advantage of having class notes through their e-mails. This limited perspective needs to be modified, and even more important the other three KM factors should be taken in account to get an integral plan for implementation.

Existing university culture promotes cooperation but at the level of research projects or through formal meetings and participation in academic committees or seminars designed to discuss didactic practices and curricula. However, additional free knowledge sharing is perceived as a potential risk to job security then some professors may be reluctant to give up this intangible asset. Therefore organizational trust needs to be developed along with the implementation of incentives designed to encourage teaching-expertise sharing. Trust on individuals, i.e. who is going to use the collected information and how, also needs to be developed by assuring professors the intellectual property of their original didactic materials and practices.

Technology and knowledge management leadership also requires definition; the technical area championed the introduction and is the most conscious about its potential. However, this support area does not have the authority and economic resources required to develop a KM system that could require the introduction of other technologies. The academic area seems to be the more appropriate knowledge leader because professors are the active knowledge generators and users; but first academic authorities need to revise the perceptions and determine which knowledge pieces could be more relevant to preserve in order to improve faculty didactic capabilities. As technology and knowledge leader, the academic authorities will need to inform the rest of the faculty about the advantages to use the simulation and to constantly check, use and discuss the information in the knowledge database. This database needs to be carefully designed and supplied not only with class notes and discussions but with other relevant information faculty and academic authorities regard as valuable.

With respect to the last factor, the establishment of the Chief Knowledge Officer position is suggested in order to concentrate responsibility and authority. This person should be able to align the goals of the three participant functions - academic, administrative and technical- and to elaborate a joint strategic plan that takes in account the available technology characteristics, the economic resources and the human perceptions.

CONCLUSIONS

The technology is perceived by its final users, the university faculty, as a useful educative tool to improve lecturing, to organize class materials and distribute notes to students. However there is also a risk perception with respect to the use that inhibits knowledge sharing. The training workshop offered the elements to develop the technical capabilities required to use the simulation but did not provide the necessary information potential as a supportive technology for knowledge management or the university's plan to assure the intellectual property of the registered information. The actions defined to manage the technology change were mainly oriented to develop technical competences, social and individual factors such as the university culture and professor's motivations to use the technology were not considered. Moreover, the goals were not clearly stated, it was presented more as another technology for the classroom than a technology that facilitates knowledge recovery and diffusion. An integral plan for the administration of the technology change is strongly recommended (Erosa and Arroyo, 2007).

Technology authorities that "champion" the introduction have different perspectives for the technology because they are related to different functional areas: administrative, technical and academic. The technical area was the main supporter and has the better comprehension about the technology contribution for a knowledge management system. However this support area does not have enough authority or credibility to encourage faculty to cooperate in the KM project. The administrative area is convinced of the potential benefits for a KM system but is concerned about the economic investment required to integrate it. This area has a stronger influence on end users but does not have the better competences to define the contents for the knowledge database, the knowledge organization framework, and the better way to distribute the information. Finally there is the academic area which is mainly supporting the introduction promoted by the other two areas. This academic area is the most suitable for the knowledge management role given its influence on faculty and expertise to recognize valuable information created during class discussions and lectures. But first the academic area will need to revise its own perceptions about the technical potential. The technology change model will need to be developed

through a collaborative effort by the three areas and responsibilities to solve critical issues such as KMS maintenance, diffusion strategies and the development of an organizational culture that fosters cooperative involvement and trust. The establishment of the Chief Knowledge officer position is recommended as the first step for the development of the technology change program.

From a practical point of view it is suggested that potential users that have completed the technology training workshop, move on by designing at least two sessions of the course using all the features. Supervision, support and modifications to these sessions by the technical area on a personal basis are identified as the best way to clarify operational issues during the teaching activity.

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