TEACHING INFORMATION SYSTEMS DEVELOPMENT USING “VIRTUAL TEAM” PROJECTS

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TEACHING INFORMATION SYSTEMS DEVELOPMENT (ISD) USING “VIRTUAL TEAM” PROJECTS

Abstract

In this paper, we discuss our experiences in designing and implementing a “virtual team” systems development project that enabled us to incorporate the different types of knowledge relevant to teaching Information Systems Development (ISD) and the different stages of learning applicable to students in institutions of higher education. We outline some of the unique advantages as well as potential pitfalls that professors interested in adopting this project structure should be aware of. We also provide a framework that can guide the design and evaluation of ISD courses.
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INTRODUCTION

With the rapid developments in electronic communication and computer technologies, there have been many predictions and much hype about how these technologies will revolutionize the educational processes of universities in different disciplines including business administration. However, based on a preliminary analysis of technology initiatives in business schools, Leidner and Jarvenpaa (1995) concluded that “initial attempts to bring information technology to management education follow a classic story of automating rather than transforming... In the absence of fundamental changes to the teaching and learning process, such classrooms may do little but speed up ineffective processes and methods of teaching.”

In this paper, we discuss our attempt to transform, not just automate, the delivery/facilitation of our classes using an innovative project design requiring students to work in “virtual” systems development teams. Specifically, we cover the theoretical perspectives that have informed our thinking on teaching information systems development (ISD), the objectives guiding the project design, the tangible and intangible benefits students participating in the “virtual team” projects have experienced and reported to us, potential pitfalls in conducting such projects, and finally, future directions.

THEORETICAL PERSPECTIVES

Our own backgrounds

Human action often reflects the theories held by the concerned actor regarding the domain of application (Argyris and Schon, 1978). By extension, this implies that the theoretical assumptions and beliefs that an academic holds dear, informs not only how the person conducts research, but also how he/she teaches or how he/she believes a course must be taught. We (the three co-authors) discovered how similar our concerns and aspirations were regarding the classes we were teaching, even though we were based in different universities in two different countries. We could trace our common set of concerns to our similar (though not identical) meta-theoretical and epistemological commitments in our individual
research programs, which in a broad sense may be characterized using terms such as interpretive, constructivist, sociotechnical, process-oriented, non-deterministic and emergent, conceptual, and action-oriented seeking to integrate research and practice (Markus and Robey, 1988; Lee, 1991; Orlikowski and Baroudi, 1991). On self-reflection, we found that we enacted (and sought to further integrate) these beliefs in our classrooms as we taught ISD to our students.

Based on our exposure to (and commitment to) sociotechnical thinking (Mumford, 1995) and interpretivism (Orlikowski and Baroudi, 1991), we were convinced that systems design and implementation should not be viewed as a technical activity alone, but as an activity that is simultaneously social and technical (Davis et al., 1992). Rather than considering the systems requirements as unambiguously known, we chose to view requirements analysis as the most significant road-block in designing and implementing a successful information system. Having adopted this view, we could see why Churchman and Schainblatt (1965) saw mutual understanding as an essential ingredient of successful systems implementation. Thus, we needed to incorporate some mechanism in our classes for future systems designers (i.e., our students) to develop skills of communicating and interpreting symbols. These skills would enable them in their future role as systems designers to attain a state of mutual understanding with other relevant social groups (say, the users) whose members did not share the designers’ frames of reference, and vice versa.

Types of knowledge

We also realized, drawing on our epistemological beliefs, that the practice of information systems development (ISD) requires different types of knowledge, some of which were being consistently under-emphasized within the traditional models of IS teaching. Drawing on the work of Rockart and Scott Morton (1975), Lee (1991), Hirschheim and Klein (1989), and (most significantly) Astley and Zammuto (1992), we came to identify three broad forms of knowledge in the domain of ISD:

1) Facts and definitions are the presumed truths and objective descriptions of technologies and concepts. Straightforward answers to the following questions, for example, would be included in this category.

- What is a DSS?
• Define generalization/specialization.
• State the advantages of a “data-oriented approach” to systems design over a “process-oriented” approach.
• When is a relation said to be in BCNF?
• What is a 4 GL?

In imparting this kind of knowledge, the role of the professor is to act as a (perhaps privileged) source and/or conduit of information. Mastery of such knowledge by students involves more “memorization” than “understanding.”

(2) Knowledge of technology and techniques refers to the instrumental or “how to” knowledge that allow students to solve certain class of problems that fit the structure or utilize the easily apparent capabilities of the tools and techniques. In a sense, the role of the professor imparting this type of knowledge is to act as an “expert,” who would illustrate the technology and techniques through the use of “paradigmatic problems” which can serve as problem-solving templates for students. Examples of technology/techniques knowledge include:

• When you wish to represent a relationship between a many-to-many relationship and another entity, use aggregation.
• To transform a 2NF relation to 3 NF, remove the transitive dependencies.
• ... this is how (or why) you create a structure in C language...
• The PERT and GANTT charts can be drawn in Microsoft Project in the following way...

It is important to note that this knowledge goes beyond definitions, since the above statements are not very valuable unless the student actually learns to use the knowledge contained in the statements for problem solving. Also, it is worth mentioning here that the traditional educational model assumes that by providing students with “drills” of solving simplified problems that fit the techniques/technology, they would become capable of using this form of knowledge in a different context (i.e., the “real world”).

(3) Social knowledge: As mentioned above, owing to our sociotechnical orientation, we recognized the importance of not only the above forms of knowledge but also another category of knowledge, which we call “social knowledge.” This form of
knowledge, in our context, refers to a practicing systems analyst/designer’s understanding of social phenomena associated with ISD, and the knowledge that would enable him/her to explain and predict behaviors of social entities (organizational units, different stakeholders, etc.).

*Social knowledge* can further be divided into:

3 a) *Propositional knowledge*: This type of knowledge is instrumental in nature and focuses on the means that lead directly to some pre-defined ends in the social arena. Knowledge having the structure: a) If <specific problem>, then <specific solution>; or b) outcome = Function (factor 1, factor 2,…. factor n), where factor i may represent necessary, sufficient, or moderating conditions, may be viewed as propositional. This type of knowledge is most popular since, on superficial examination, it is *perceived* to satisfy the usefulness/applicability criteria in the “real world.” Teaching propositional knowledge requires the teacher to play the role of an expert who articulates well-defined rules and then illustrates the rules through carefully formulated applications (real-world cases simplified to fit the knowledge) or specific success stories arising from the use of such knowledge. It is assumed that by transferring the propositional knowledge to students effectively, they (the students) can recall and then unproblematically apply the knowledge in response to certain stimulus (i.e., in appropriate contexts). Examples of such knowledge include:

- Communication leading to mutual understanding is the key to effective information requirements analysis; and
- A prerequisite to successful systems implementation is a “fit” between the technology being implemented and the surrounding social system.

It is worth noting that a vast majority of academic IS research, especially within the behavioral positivist tradition is directed towards the creation and validation of such knowledge.

3 b) *Conceptual knowledge*: This refers to concepts that allow us to see the world in different ways. This knowledge is not directly applicable, but needs to be merged with a specific context and processed in the mind to derive implications for action. In other words, conceptual knowledge needs to be converted to instrumental knowledge by the knowledge users themselves before it can be utilized. It is our belief that most issues relating to ISD are so complex and so dependent on the unique context, that it
is impossible to create universal propositions or techniques that are directly applicable in any context. In such a circumstance, conceptual knowledge becomes extremely valuable. Teaching conceptual knowledge involves acting as a facilitator in the process of exploring abstract concepts and theories jointly with the students. The objective of teaching conceptual knowledge is not to provide "information" or a "set of rules," but to help each student create possibly unique skeletal non-deterministic conceptual schema in his/her mind, or to assist in the integration of a new set of concepts in his/her existing schema. As students gain experience in the "real world," they iteratively modify their schema, and add more "flesh" to the skeletal framework. Eventually, they become "experienced professionals," having developed a very rich schema that is based on the conceptual knowledge fundamentally constructed in school but enriched through reflective practice.

Topics such as the Leavitt’s diamond model of organization, social construction, the hermeneutic circle, metaphor of “text” to understand action, etc. are examples of conceptual social knowledge that could enable students to design better systems through better information requirements elicitation and to implement systems more effectively. Researchers within the behavioral interpretivist traditions appear to be primarily engaged in the creation and dissemination of this type of knowledge.

3 c) Finally, we discuss symbolic knowledge (Astley and Zammuto 1992). This refers to two related types of competencies:

- **The knowledge that is used to legitimize actions/decisions:** As Information Systems professors, we must recognize the possibility that our students go to work in a world that is governed less by principles of technical rationality and more by power, politics, and institutional assumptions. If such is the case, then access to (and application of) symbolic knowledge becomes very critical to the success of our students. For example, in certain work environment, knowledge contained in privileged sources (such as Harvard Business Review, article by Bill Gates or James Martin, etc.) becomes important not because of their rational and conceptual merits necessarily, but because of the retrospective justification that such sources can provide for a chosen course of action (Astley and Zammuto, 1992).
• **The use of / interpretation of symbols:** Perhaps, a different but more relevant aspect of symbolic knowledge is that to be an effective participant in ISD, it is important to develop the skills for using and interpreting symbols (utterances, text, pictures, etc.) in an effective manner (e.g., Sarker and Lee, 1999; Hirschheim and Newman, 1991).

As IS researchers interested in social analysis, our exposure to the tradition of symbolic interactionism allowed us to see the importance of this form of knowledge in ISD. From this perspective, the role of the professor involved in the education of students who will work in the real world of Information Systems would be: 1) to point to sources of information, vocabulary, rhetoric, methodologies, and appropriate symbolism that are considered legitimate (or are valued) in relevant social groups; 2) to act as a linguistic guide who would sensitize students to the importance of professional vocabulary, rhetoric, and other appropriate symbolic communication; and 3) to provide students with an opportunity to practice and improve their application of symbolic knowledge.

Based on the ideas presented above regarding the different types of knowledge relevant in ISD (including implementation), we concluded that any ISD class should be designed in a way so as to incorporate all of the above types of knowledge in a balanced manner.

**Stages of Learning**

We, like many other colleagues before us, also recognized that learning is not a one shot phenomenon, but actually involves a series of analytically separable steps. While there are a number of models on learning, for this paper, we adapt Rockart and Scott-Morton’s “general learning model” (1975, p. 20) that was proposed to help understand the learning process in higher educational institutions. According to this model, learning occurs in four progressive stages:

- **Acquisition** – in this stage, the learner is exposed to and asked to remember basic facts and definitions.
- **Embedding** – in this stage, the student thinks through facts, skills, and processes learned, and applies what he/she has learned in simple applications.
- **Integration** – in this stage, “the student moves from the rote acquisition of material to its incorporation and subjugation into more global conceptual structures” (p. 21).

- **Testing** – in this stage, the student tests the implications of what is learned in new and realistic contexts. This also provides an opportunity to revise the theories of action the student may have developed (Argyris and Schon, 1978) in the earlier stages of learning.

  We could see that most ISD classes in universities do not consciously lead (and in most cases, do not even attempt to lead) a student through the four stages of learning suggested in the “general learning model.” We wanted to make a deliberate attempt to incorporate all four stages in our course.

  To summarize our discussion, having recognized the need for a more comprehensive view on ISD courses, we wanted to design a course that would span all the different types of knowledge identified above (facts and definitions, knowledge of technology and techniques, propositional social knowledge, conceptual social knowledge, and symbolic social knowledge) as well as the four stages of learning (acquisition, embedding, integration, and testing). The above discussion is summarized as a framework (Fig. 1.) that may serve as a useful map for designing or evaluating IS courses. Without getting into detailed arguments, we would like to note here, that we believe that the "typical" ISD course appears to be weak in cells C4, C7, C8, C11, C12, C15, C16, C17, C18, C19, and C20, and we wished to address the identified deficiencies to the extent possible in our course design.

**COURSE DESIGN**

**Objectives**

Specifically, the design objectives for our ISD course were the following:

- Expose students to the complexity of real-world systems development and implementation;

- Illustrate the socio-technical nature of information systems, involving the use of techniques and technologies based on computer sciences, and of design principles or guidelines based on social sciences; and
• Adopt a balanced approach towards the various forms of knowledge and the different stages of learning.

Course design

The ISD-related courses that we designed at our two universities consisted of lectures, assignments, and a virtual team project. The lectures and assignments were modeled on the traditional modes of teaching ISD concepts and skills, focusing primarily on facts and definitions, knowledge of technology and techniques, and propositional social knowledge. Also, the lectures and assignments were geared toward the first two stages of the learning model (acquisition and embedding). The virtual team project had two main goals: 1) to help the student pass through the remaining two stages of learning (integration and testing) regarding technology and techniques by providing a real context for application that was not artificially bounded, and 2) to simultaneously facilitate the embedding, integration, and testing of social knowledge, especially conceptual knowledge and symbolic knowledge.

It is useful to point out at this stage that, while in principle, the traditional face-to-face team projects can also achieve the two goals stated above, we believe that virtual team projects are likely to be more effective in achieving the goals. The time/space separation in a virtual context results in the lack of shared norms regarding collaboration among the team-members and interaction with the client. Consequently, complexities arising from social factors tend to get magnified, and thus, a majority of team-members are forced to reflect on the issues, and learn to creatively apply social knowledge to solve or at least mitigate the problems. In contrast, in face-to-face teams developing systems having information requirements of comparable (low) complexity, many of the social complications do not surface or can be dealt with intuitively by team-members without deliberate application of social knowledge. It appears that students working in face-to-face teams for their term projects focus primarily on the application of technology/techniques related knowledge. Most fail to appreciate the importance of different types of social knowledge (especially, symbolic knowledge) that could be extremely valuable during the development of large-scale information systems for complex organizations with

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2 Of course, we recognize that readers may disagree with our view, since we offer no systematically gathered empirical evidence. Resolving this empirical question may, in itself, be an interesting research project.
different stakeholder groups who do not have shared frame of reference, or when working in globally distributed teams (Jarvenpaa and Leidner, 1999) for systems development. In fact, in our experience, traditional face-to-face student team-members are far more concerned about other team-members not doing their share of work (a concern that is less important in the “real world”) than about understanding social aspects such as user-analyst or analyst-developer relationships/communication patterns to develop/clarify systems specifications for individuals not having a shared frame of reference, and to develop strategies for coordinating and managing relationships among members of the ISD team.

In the rest of this section, we provide a description of the virtual team project. We focus on the project, since it was our primary vehicle for rectifying (what we saw as) the limitations of traditional courses in ISD. We felt that a virtual team project would be helpful in reflecting the reality of today’s geographically separated systems development teams. Also, because of the time-space separations among team-members in this project, they would be forced to confront problems of time coordination and lack of shared frame of reference, which would, in turn, enable them to acquire/internalize social knowledge (especially conceptual and symbolic knowledge) in addition to the other forms of knowledge that they would acquire through more traditional mechanisms such as lectures and assignments. In addition, since students would be building prototypes for real businesses with actual information problems that did not neatly fit into the textbook templates, they would have to go through the latter two stages of learning over the course of the project.

In our specific context, the virtual teams were comprised of students from two different North American universities working collaboratively to formulate a business information systems problem, converting it into a (database) systems design, and then developing a working prototype. More specifically, the participants were students enrolled in Information Systems courses at two large North American Universities, one based in Canada (which we call UA) and the other in the U.S. (which we call UB). Typically, each virtual team consisted of 4-5 "internal" or "local" group members who were matched with 4-5 "external" or "remote" members from the other university. Thus, each virtual team consisted of about 8-10 members drawn almost equally from UA and UB. The projects lasted for about 14 week-long semesters.
The task assigned to each virtual team was to define, design, and develop an information system for a "real" organization. The UA members of each virtual team acted as “business systems analysts” and were responsible for going into an organization and identifying a “problem” situation that they believed needed resolution using a computer-based information system. They were then supposed to create a rich narrative of the problem in the form of an “information requirement document” (IRD) which had to be then transmitted to their counterpart external team members at UB who were acting as “systems designers.” In addition, UA members were required to provide a preliminary design of the user-interfaces that would be preferred by the organizational clients. The UB members of each team were then responsible for creating a detailed systems design (including an Entity-Relationship or E-R diagram) and a working prototype of the database system. Finally, UA and UB team-members were to make a joint presentation (using videoconferencing technology) of their entire project, including the working prototype. In Table 1, we list the participants in this project. Next, in Table 2, we summarize the different events of the project with the associated time-lines.

### Table 1: Project participants

<table>
<thead>
<tr>
<th>Main Participants</th>
<th>Brief description</th>
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</thead>
<tbody>
<tr>
<td>UA members</td>
<td>Members of virtual teams who were students at UA. Primarily involved in interacting with the clients and defining information and end-user interface requirements</td>
</tr>
<tr>
<td>UB members</td>
<td>Members of virtual teams who were students at UB. Primarily involved in logical design and implementation of the system based on specifications created by UA members in their teams.</td>
</tr>
<tr>
<td>PA</td>
<td>Professor facilitating the virtual teams from the UA side</td>
</tr>
<tr>
<td>PB</td>
<td>Professor facilitating the virtual teams from the UB side.</td>
</tr>
<tr>
<td>Companies (each team interacted with a different company)</td>
<td>Located in the same city as UA. UA members interacted with company representatives to define the systems requirements.</td>
</tr>
</tbody>
</table>

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3. This was an appropriate role for UA members since their course focused on analysis of requirements for MIS and DSS.
4. The “systems designers” in our context (i.e., UB students) focused on database systems development since the ISD class in which they were enrolled was on database systems.
Table 2: Formal project structure

<table>
<thead>
<tr>
<th>Phase of the Project</th>
<th>Timeline (in weeks)</th>
<th>Event Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase I: Formation of the team and creation of work plans</td>
<td>Week 0 to week 4</td>
<td>Event 1: creation of the virtual team by PA and PB</td>
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<td></td>
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<td>Event 2: Selection of organization by UA members for which the virtual team would develop a system</td>
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<td>Event 3: introductory videoconference #1</td>
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<td>Event 4: completion of project proposal by UA members</td>
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<tr>
<td>Phase II: Defining the business problem</td>
<td>Week 5 to week 8</td>
<td>Event 5: Completion of the Information Requirements Document (IRD) by UA members</td>
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<tr>
<td></td>
<td></td>
<td>Event 6: Videoconference #2 to clarify the contents of IRD</td>
</tr>
<tr>
<td>Phase III: System design, development and delivery</td>
<td>Week 9 to week 14</td>
<td>Event 7: Completion of conceptual/logical design by UB members</td>
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<tr>
<td></td>
<td></td>
<td>Event 8: Completion of user interfaces by UA</td>
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<td></td>
<td></td>
<td>Event 9: Prototype delivery by UB members and joint presentation in videoconference #3</td>
</tr>
</tbody>
</table>

**BENEFITS DERIVED FROM THE PROJECT**

We discuss some of the perceived benefits from the project, drawing on quotations from student reports, recruiter comments, as well as our personal experiences.

**Views of students**

The following representative quotations of students after completing the project provide evidence regarding the benefits that students perceived (emphasis added).

**QUOTATION 1:** Overall this was a true learning experience. Our group got to see what it takes to complete a project with a group thousands of miles away. We learned that time management was essential, and learning about team members’ background early in the project is crucial in completing the project. Some technical skills that we learned were ICQ, Access, Database coding, interactive communication through videoconferencing and web-board. We discovered that each culture has its own customs and one must adapt to those differences if the group is to work well. The most important thing we learned was communication skills. We learned that communicating effectively with your (virtual) counterparts is crucial, and if communication breaks down then there is little chance for success. Fortunately for us, we were able to cross all cultural and communication barriers and put it all together through team effort.

**QUOTATION 2:** I think that as companies grow and expand throughout the world, the use of virtual teams will become vital. The concept of using virtual teams is highly beneficial as it prepares us to deal with other people in other locations. I learned that MS Access is a
powerful tool. I learned to manipulate it through SQL and through Visual Basic. But most importantly, I think I learned to deal with other people in multiple contexts and in different situations... this project enabled me to see that cooperation is the key ingredient to a successful project.

QUOTATION 3: In my opinion, the experience of this project has been outstanding. The collaboration really gave exposure to the workings of a “real world” project, from start to finish, with all the technical, organizational, and human challenges one would expect in a business scenario.

QUOTATION 4: At first, I was hesitant to accept that this local-remote idea would be beneficial to the project but after completing the project, I realize it has been. We have learned database systems and we have also gained an unusual and unique experience. We have created a database system and application without ever meeting (in person) the customer. I have learned many technical lessons. Primarily, how to produce a product that meets the expectations and requirements of someone else. In most class projects that I have worked, we have had to develop our own project. Developing a project for a remote group mimics the real world much more accurately.

Our (the professors’) interpretation

The four quotations capture a number of lessons that students took away from the course. They also indicate that the goals of the course design were accomplished to an adequate degree. First, it appears that the participants had an opportunity to integrate and test their knowledge about technology/techniques (SQL, VBA, EER Modeling, DSS design, etc. that were covered in the lectures) in a new real-life context, where the problems did not necessarily match the structure of the examples covered through lectures and assignments. This allowed the students to become significantly more competent in the technical domain. Furthermore, being located in a rural campus town, students in UA had a welcome opportunity to develop systems for clients from large/mid-sized organizations located in the home city of UB. This opportunity to develop systems for such organizations was seen as particularly valuable by UA members, given that the typical term projects undertaken by UA students in prior offerings of this course involved clients such as the local video store, student clubs, bicycle repair shop, and so on. Certainly, many of these clients were not the types that the students would deal with in their jobs.
after graduating from the program. Thus, it is clear that the virtual team project helped meet the objective of bringing realism to the ISD educational process.

Another important issue that is reflected in virtually every quotation is that the students could appreciate the socio-technical nature of ISD. Such appreciation is extremely difficult to attain just through lectures and assignments, or by stating the importance of sociotechnical thinking by “rote” in propositional form. The opportunity to innovatively “try out” some of the conceptual knowledge contributed to the internalization and enrichment of the students’ conceptual schema, thus advancing a student from a novice towards becoming an expert.

Similarly, the students participating in the project could comprehend the importance of dealing with gaps in communication, culture, and contexts, the lack of shared frames, and complexities in working across time zones. Their comprehension was considerably more profound than what could be expected from their attending lectures where an instructor droned “propositions” such as “Communication is necessary for successful ISD.”

Finally, the level of competence in the use of symbols gained by participants is beyond question, and this is evident from their careful use of “evocative” and “referential” symbols (Couch, 1996). Students also appeared to have realized the importance of building team norms for guiding argumentation and other forms of communication through the life-time of the project. Finally, students obtained experience in using rhetoric and legitimate sources of knowledge to convince remote members about courses of action (e.g., design decisions) that members on one side wanted to pursue.

All in all, students appeared to have experienced some complexities of the real world, comprehended the sociotechnical nature of ISD, experienced the different types of knowledge, and moved through the four stages of learning, thereby satisfying some the objectives that had been set forth for the course. However, more formal evaluation is certainly necessary in order to make a definitive claim.

We also received higher teaching evaluations (and/or more positive comments) for course offerings that involved the virtual team project, that may be

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5 Evocative symbols are directed towards developing social solidarity.
6 Referential symbols denote objects, events, and sequences referred to during communication, and are useful in coordinating communication processes.
reflective of higher students satisfaction with the learning process (and perhaps, partially, the novelty of their experience). Students were exposed to a number of communication technologies and formed long-term professional networks with local members, and in some cases, with remote members. Also, students who participated in our project had something interesting to say during campus job interviews. For example, in response to an interviewer’s question “Can you tell me about any challenging project you have done in your MIS classes?” students were able to enthusiastically respond and narrate their experiences and lessons learned. In fact, we have received very positive feedback from recruiters who visited our universities. For example, the lead recruiter of a reputed insurance company, sent the following e-mail to one of the co-authors after interviewing students who had participated in the project:

…One of the interview questions I always ask is what the student’s favorite class is. Almost every [university name] person I interviewed mentioned your [course name] class. That speaks volumes for the things you are doing with your students and I’m very much looking forward to seeing some of this first hand on my next visit.

Not surprisingly, some employers have sought and actually hired our students often based on this unique experience of working in virtual teams.

**POTENTIAL PITFALLS**

We hope that the reader would agree that there was significant value addition achieved through the IT-enabled change in the way the ISD skills were taught as part of our “teaching experiment.” However, we hasten to add that benefits came at a cost. The project drained resources (our research time, as well as department funds – used mainly for videoconferencing). In addition, problems encountered in the design, development, and implementation were open-ended; thus the professors as well as the teaching assistants had to work much harder and be more closely involved with each team’s project. Sometimes technologies did not work. For example, the videoconferencing equipment did not function for several hours on a Saturday with all students waiting impatiently for their team’s turn. The likelihood of students being frustrated was extremely high, and this put severe stress on us, the professors, who, unfortunately, have to sometimes worry about teaching evaluations. Students appeared to get frustrated with the facts that:
• Videoconferences were held on Saturdays, due to schedule conflicts of different students/facilitators, and limited availability of videoconferencing facilities.

• The local and especially remote members were often perceived to be unresponsive and uncooperative, and technologies were not available all the time (e.g., Web-board was down for few hours).

• Sometimes, from the point of view of the UB members, the UA team-members, in their effort to impress the organizational clients, provided UB members with unrealistic specifications and deadlines. Likewise, UA team-members felt that UB members were technically inept, and were not putting in their best effort;

• There was limited guidance available from the teaching assistants regarding technical problems encountered in implementing some features requested by users;

• Remote team-members had different/incompatible schedules (In fact, we deliberately did not align the UA and UB course structures completely in order to retain some of the complexities of real-world collaboration between two companies with different goals, priorities, and schedules);

• There were uncertainties with respect to the outcome of their project (and thus grades!).

Finally, with all the stress experienced by students, teaching assistants, and the facilitators (i.e., the co-authors), there was always a possibility of a breakdown in relationship among the different parties involved, especially among the three co-authors coordinating the project. While we were fortunate in this regard (i.e., we did not experience breakdowns amongst us), and received excellent (i.e., much higher than usual) teaching ratings and seemed to have earned the respect of many perceptive students, colleagues considering such projects should be aware of potential problems and develop contingency plans as part of the project design to mitigate negative effects if things do go wrong.

FUTURE DIRECTIONS & CONCLUSION

The model for teaching ISD using lectures, assignments, and virtual team-projects discussed in this paper can be effective in delivering a course that seeks to holistically incorporate the different types of knowledge and stages of learning.
Figure 2 summarizes the theoretical arguments made in this paper regarding the types of knowledge relevant to ISD and the stages of learning that students need to go through as part of an ISD course. Future research would involve refining the ideas further and designing appropriate instruments that can facilitate the evaluation of effectiveness (as perceived by the students) of the different elements of our ISD course. Such empirical evidence would allow us to “objectively” validate (or invalidate) our claim that the course design presented actually integrates the different types of knowledge and encompasses the four stages of learning, and if such a holistic approach to ISD education is at all viewed as valuable by different stakeholders.

In addition, it would be useful to evaluate the incremental contribution of the “virtual team project” over a traditional ISD “team project” based on the experiences of a “control group.” This can be accomplished by teaching two sections of the ISD course in an identical manner, other than the fact that the students in one of the sections do not participate in the “virtual team project” but instead participate in face-to-face systems development team projects. Again, this would serve as an empirical validation or falsification of our arguments presented in this paper indicating the virtual team project participants would have a more comprehensive learning experience that those involved in face-to-face team projects.

To conclude our paper, we would like to enthusiastically invite Information Systems educators to incorporate similar strategies in their teaching, which can be very rewarding and fulfilling to the teacher as well as to the students, and also provide a number of interesting research avenues for the professors involved. However, we must add a strong word of caution — the project requires a great deal of planning and effort in order to have a chance to succeed. In addition, absolute trust and respect (and perhaps friendship) is needed among the professors facilitating such complex projects to manage the ups and downs. In the absence of trust and respect, the project is likely to be run into trouble during the term, with disastrous consequences in terms of the concerned faculty members’ reputation and teaching evaluations.
REFERENCES


FIG. 1: A MAP FOR DESIGNING AND EVALUATING IS COURSES

<table>
<thead>
<tr>
<th></th>
<th>Acquisition</th>
<th>Embedding</th>
<th>Integrating</th>
<th>Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facts and Definitions</td>
<td>C1</td>
<td>C2</td>
<td>C3</td>
<td>C4</td>
</tr>
<tr>
<td>Technology/ Techniques</td>
<td>C5</td>
<td>C6</td>
<td>C7</td>
<td>C8</td>
</tr>
<tr>
<td>Propositional (social)</td>
<td>C9</td>
<td>C10</td>
<td>C11</td>
<td>C12</td>
</tr>
<tr>
<td>Conceptual (social)</td>
<td>C13</td>
<td>C14</td>
<td>C15</td>
<td>C16</td>
</tr>
<tr>
<td>Symbolic (social)</td>
<td>C17</td>
<td>C18</td>
<td>C19</td>
<td>C20</td>
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</tbody>
</table>
FIGURE 2: A FRAMEWORK FOR EVALUATION

<table>
<thead>
<tr>
<th>Type of knowledge with examples</th>
<th>Role of the professor (and IT)</th>
<th>Component of class design</th>
<th>Acquisition</th>
<th>Embedding</th>
<th>Integration and generalization</th>
<th>Testing in new situations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FACTS AND DEFINITIONS</strong></td>
<td>Professor provides information. The Role of IT is to aid in information dissemination.</td>
<td>Lectures</td>
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<tr>
<td>• What is a DBMS?</td>
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<td>• Define generalization/specialization</td>
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<td>• State three advantages of the data-oriented approach.</td>
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<td>• A relation is in BCNF if every determinant is a candidate key.</td>
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<tr>
<td><strong>KNOWLEDGE OF TECHNOLOGY/TECHNIQUES</strong></td>
<td>The role of a professor is to “teach” a student how to use the technology/Technique, and illustrate it with paradigmatic examples</td>
<td>Lectures</td>
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<tr>
<td>• When you wish to represent a relationship between a many-to-many relationship and another entity or relationship, use aggregation.</td>
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<td>• To transform a 2NF relation to 3NF, remove the transitive dependencies.</td>
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<td>• The PERT and GANTT charts can be drawn in Microsoft Project in the following way...</td>
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<tr>
<td><strong>SOCIAL KNOWLEDGE – PROPOSITIONAL</strong></td>
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<td>Lectures</td>
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<tr>
<td>• Communication leading to mutual understanding is the key to information requirements analysis</td>
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<td>• A prerequisite to successful database design is to develop the conceptual model based on the views of the different stakeholders (in the external schema)</td>
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<tr>
<td>• Communication leading to mutual understanding is the key to successful project management</td>
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<tr>
<td><strong>SOCIAL KNOWLEDGE – CONCEPTUAL</strong></td>
<td>The professor acts as a “facilitator” in exploring abstract concepts and theories jointly with the students, and helping to create (unique) skeletal non-deterministic conceptual schema in students' minds.</td>
<td>Lectures</td>
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<td>• The Leavitt’s diamond model of organization; Social construction; the hermeneutic circle; metaphor of “text” to understand action, etc.</td>
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<td>• Expanded aspects of propositional knowledge</td>
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<tr>
<td><strong>SOCIAL KNOWLEDGE – SYMBOLIC</strong></td>
<td>A professor’s role is to act as a guide in the use of language and other symbols – he/she sensitizes students to political realities of the workplace; also acts as an organizer of a forum for students to practice their “professional” vocabulary and rhetoric in presentations/Argumentation.</td>
<td>Lectures</td>
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<td>• Participation in a real virtual team systems development project.</td>
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<td>• Using videoconferencing (novelty)</td>
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<td>• Skills related to reading and displaying communication symbols</td>
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