LESSONS LEARNED IN A COLLABORATIVE DEVELOPMENT PROJECT - DOCUMENTATION FOR PHYSICAL THERAPY EDUCATION

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ABSTRACT

The use of information systems in healthcare has lagged behind other industries. In addition, documentation by healthcare professions are legally mandated yet can create a burden on the part of the practitioner to capture the necessary data. This is particularly true in the Physical Therapy profession, where a move to evidence based practice, as with other healthcare professions, makes automated documentation of patient data a prerogative. Based on the collaboration between a Physical Therapy and Computer Information Systems Department, a set of input screens was prototyped to develop a computerized documentation system for Physical Therapy students. Benefits that accrued to students involved in the project are discussed, in addition to conditions that impact student resistance. Other educational concerns that were identified throughout the two semesters that the project lasted are identified to assist future endeavors.

Keywords: health care systems, collaboration, human computer interaction, system analysis and design

I. INTRODUCTION

Unlike many other industries, information technology has yet to transform the healthcare

delivery system in the United States (Lieber, 2003). Yet, with the anticipated growth of healthcare professions in the United States over the next decade and advances in information technology, it is inevitable that information systems in the healthcare environment will be more broadly adopted.

Health professions are frequently listed among the top and fastest growing careers. In a recent study, over 20 percent of the top 50 jobs were in healthcare and related professions (Money Magazine, 2006). This projected increase in demand is currently being met by academic programs designed to create a larger and broader set of healthcare professionals.

In addition to educating and training students in the specifics of their healthcare professions, educators must also orient students with medical documentation systems. As information systems continue to evolve in the healthcare environment, moving from the traditional paper charts to Electronic Medical Records (EMRs), users of such systems will need to develop skills to input as well as access patient data. In addition, the education of future healthcare practitioners is evolving to include the use of information systems with the daily delivery of healthcare services.

Incorporating a computerized documentation system in the healthcare educational environment can be an expensive proposition, as it requires an adequate software application to replace the 'gold standard' of paper charts. In some healthcare professions a limited number of applications exist, causing educators in these fields to either acquire a relatively expensive set of applications or continue to have students maintain paper charts for their documentation.

To initiate the development of a documentation system for one of the growing healthcare professions, Physical Therapy, a collaborative project was initiated between departments within a College of Health Professions and a College of Business. The following manuscript presents the benefits that accrued to a department, Physical Therapy, by engaging with student teams in an undergraduate systems analysis and

design course. We examine the development of a documentation system through an initial set of prototypes for the Physical Therapy educational environment. We also discuss the benefits that accrued to systems analysis and design students, and what we learned about conducting a project with students and another academic department.

II. PHYSICAL THERAPY

Physical therapy (PT) is a health care profession whose practitioners' work primarily involves examining patients or clients with physical impairments and dysfunctions to identify the sources of those problems and then planning and implementing physical interventions, such as exercise, electricity, sound and heat, to help alleviate the problems in order to maximize the patients' ability to function. (Guide to Physical Therapist Practice, 2001; Physical Therapists, 2006). Physical therapy professionals are also gradually becoming more involved in the prevention of such physical impairments and dysfunctions. Physical therapists (PTs) and physical therapist assistants (PTAs) are licensed professionals who work in a variety of settings including hospitals, rehabilitation centers, home health, private practices and school systems.(Physical Therapists, 2006) In most countries outside the United States, PTs are generally known as physiotherapists. Both PTs and PTAs have received specialized training and education and have passed credentialing examinations. Similar to medical practitioners, PTs may choose to work as generalists or they may concentrate their efforts and become certified in specialty areas such as pediatrics, neurological rehabilitation, orthopedics, sports, cardiopulmonary management, wound management or manual therapy (Specialist Certification, 2006).

ACADEMIC PROGRAMS IN PHYSICAL THERAPY

A wide range of university programs exist to meet the demands of the PT profession. With just under 200 universities offering accredited PT programs in fifty states plus the District of Columbia and Puerto Rico (www.APTA.org), and the previously discussed demand for professionals, a host of academic degrees exist. Such programs range from the Associates degree to the terminal PhD. The PT program at a regional university in one of the Rocky Mountain States, the project sponsor, is presented.

Intermountain State University (ISU) offers one undergraduate program to train PTAs and two undergraduate programs to train and educate PTs. Students who complete the two year PTA training program typically earn the Associate of Applied Science degree. However, these students may opt to apply additional academic work toward either a Bachelor of Applied Technology or a Bachelor of Science in Health Science degree (Physical Therapist Assistant, 2006).

ISU also offers a graduate degree, the Doctor of Physical Therapy (DPT). Students who complete any undergraduate programs can also earn the DPT degree. The primary DPT program at ISU spans three years and accepts graduate students without prior PT credentialing. A second DPT program accepts only licensed PTs who have previously earned a Master's degree in physical therapy or a related field of study. This PT program for licensed professionals is conducted almost entirely on-line.(Department of Physical and Occupational Therapy, 2006) Similar to other such programs throughout the U.S., it's purpose is to upgrade the knowledge of practicing clinicians to current state-of-the-art levels. These programs are commonly referred to as transitional or bridge DPT programs. All of the above programs with the exception of the transitional DPT program involve work in the classroom as well as in a variety of clinical settings, in which students interact with actual patients or clients under the supervision of an experienced PT clinician. As part of the clinical training at ISU, DPT students may receive clinical instruction in the on-site faculty-student clinic (ISU PT/OT Associates) during their Clinical Practicum course series.

The typical scenario at the ISU Clinic involves four parties, a patient, two students, and a faculty advisor. The students work in teams for a portion of the semester. When first meeting with a patient, one student performs the initial examination and measurements while the other records the measurements. Follow-up meetings with patients follow a similar procedure, with one student measuring and the other recording examinations of specific patient concerns, i.e. knee, wrist, hand, etc.

DOCUMENTATION

As is the case with other medical professionals, PTs are required by law to document their encounters with patients and clients.(4) In many cases, appropriate documentation constitutes the basis upon which therapists or clinical practices are reimbursed for their services. In recent years, the amount of effort needed by individual practitioners to satisfy documentation requirements has increased to the extent that many PTs now feel that documentation takes away valuable time from actually working with patients who need therapy. In fact, DPT students at ISU often take up to two hours documenting a single initial patient encounter. Although computer software is now becoming available to assist PTs with documentation, the PT profession has lagged behind other medical and health disciplines in this area (Vreeman, et al., 2006). Moreover, like other health disciplines, in order to help stem the rapid growth in health care costs, the PT profession has begun to place a greater emphasis on evidence-based practice so that those patient management strategies that are the most effective and the most cost-effective may be identified and put into widespread practice.(Maher, et al., 2004) To accomplish this, a greater emphasis on gathering and analyzing patient or client data is needed, and to facilitate the process of aggregating data, greater consistency in documentation among therapists is also needed. Until recently, the technology to systematically and conveniently collect and store patient information has not been readily available for PT practice settings (Vreeman, et al., 2006).

In order to help address PT students' difficulties in documenting patient encounters during their Clinical Practicum courses in the ISU PT/OT Associates clinic, one of the PT faculty began to explore the idea of using handheld computing devices to help gather patient data at the point of contact and thereby help to automate the documentation process. After a couple of less than satisfactory attempts at developing a usable tool, he began to look into what applications were available on the market. In part because the few documentation software packages available were not within an acceptable price range for the clinic, his efforts led to collaboration with faculty and students in the Computer Information Systems (CIS) Department at ISU in the College of Business. The collaboration developed into two separate semester-long group

projects for students taking a systems analysis and design course.

III. SYSTEMS ANALYSIS AND DESIGN

The Systems Analysis and Design (SAD) course at ISU is a junior level course with a prerequisite of an introduction to programming. Students are primarily drawn from Computer Information Systems, Computer Science, and Accounting. The course follows the traditional structured analysis and design methods.

Textbooks typically used in the undergraduate curriculum have at a minimum, fourteen chapters plus appendices (Satzinger et al., 2004; Whitten et al., 2004; Marakas, 2006). Faced with the dilemma of a one semester SAD course, the instructor must make the determination regarding what material to cover. A traditional semester long SAD course may not cover the design between the end user and computer, typically referred to as Human Computer Interaction (HCI), as this topic is included in the Design section of textbooks, commonly as one of the last chapters.

A common component of the SAD course is the semester long project. SAD textbooks are often distributed with cases either within the text or as a companion text, providing the instructor with a well defined and tested teaching aid. Cases developed as textbook aids provide the instructor with a means to assess students understanding of a problem. However, such textbook cases remove the realism and ambiguity of projects with organizations that have not well defined their problems. Introduction to such organizations with 'real world' problems can assist the student in advancing their application of classroom knowledge and communications with third parties.

The course under discussion requires students to create data flow (DFD) and entity relationship diagrams (ERD). The course also requires the use of a CASE tool, Visible Analyst, in combination with prototyping using Microsoft Access. Students were instructed that their deliverables would include a statement of work, documentation in the form of DFDs, ERDs and the resulting repository in addition to a prototype corresponding with the models and reflecting the system design.

IV. COLLABORATIVE PROJECT

The projects commenced in Spring, 2005 and concluded in Fall, 2005. Prior to being introduced to the students, the PT and CIS faculty members discussed the scope of the project, necessary paperwork, and involvement of the PT faculty member. It was agreed that the PT faculty member would meet with the students a minimum of four times, with at least two of these sessions being held in a computer lab. The project was designed to require student teams to develop structured models, a corresponding prototype, a data repository, project management and summary documents. The underlying educational goals of reinforcing the linkage between conceptual and physical models, user interaction in development, and teamwork is facilitated by the structured yet applied nature of the PT project.

INITIAL PROJECT

After contact with between PT and CIS faculty, the PT faculty met with the Spring 2005 SAD students and described the clinic's practice, documentation requirements, the types of patient data that needed to be collected, and the current paper-based data collection that was in common use. The PT also provided paper forms that PT students had developed on their own to facilitate collection of patient information during initial examinations.

The PT faculty initially wanted to capture both demographic and specific clinical data in their first discussion of the project. After receiving the first set of deliverables and prototype presentation by students, the PT faculty member deemed it necessary to reduce the scope of the project.

A follow up session provided the CIS students and the client the opportunity to refine the deliverables for the first term project. At the end of the feedback session with the PT faculty member, it was agreed that the students would focus on capturing data for the initial knee examination and follow-up appointments. The knee was selected because of the frequency of knee therapy that was performed at the clinic, and the similarity between functions of the knee and those of the neck, shoulder, hand, wrist,

hips, ankles and feet. All involve the combination of muscle, bones, and ligaments that make up most human movement.

An example of the basic input screen for special tests on an examination of the knee is displayed in Figure 1. Figure 1 was accessed via a text based menu, generated by students either with code or the switchboard manager feature of Microsoft Access. The form also contains tabs for entering data on the patients Lower Quarter Screen (LQS), Range of Motion (ROM), and Manual Muscle Test/Contractile Test (MMT/CT). Data input progresses from top to bottom, left to right.

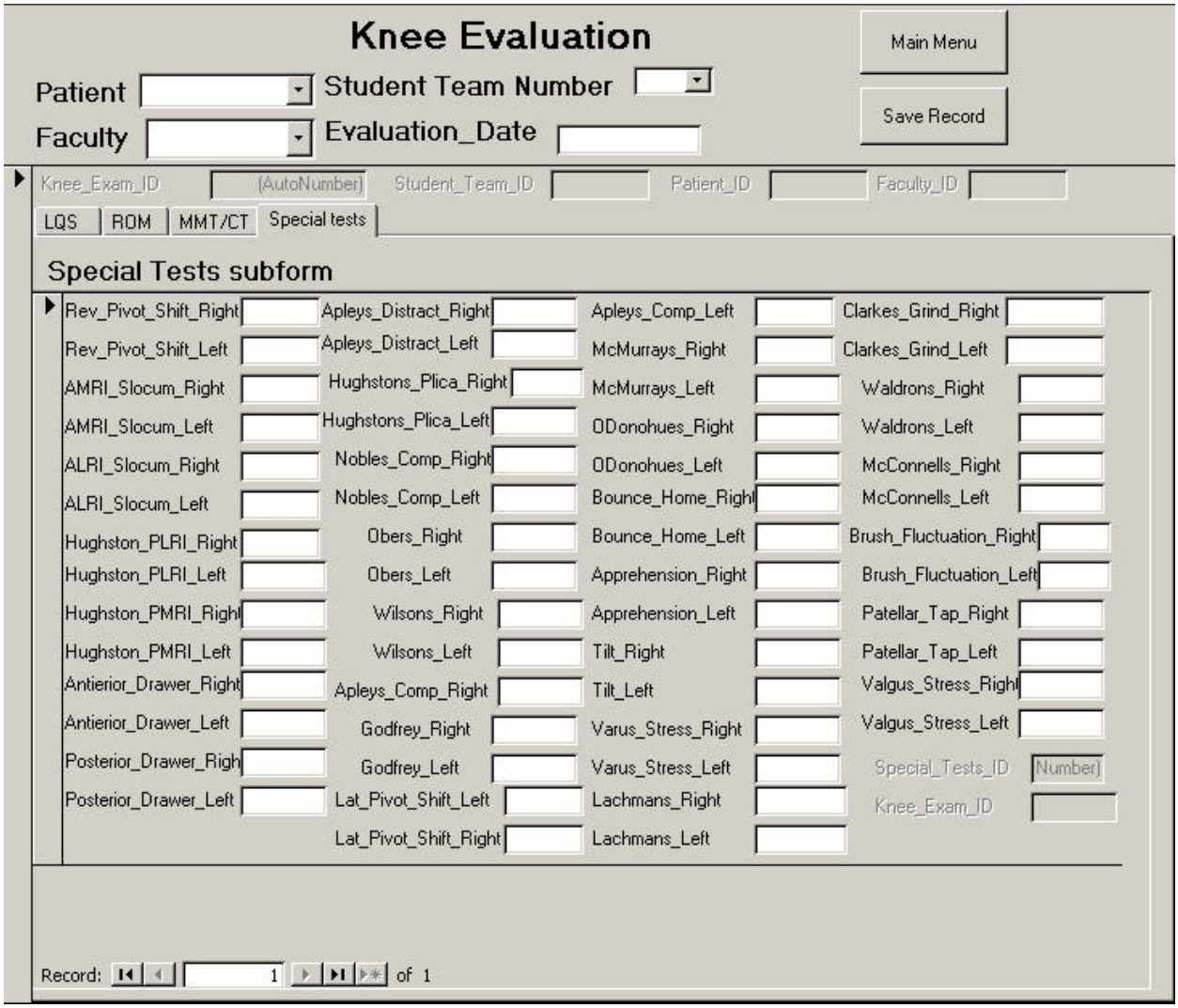

Figure 1. Knee Evaluation Screen

In addition to capturing data for examinations, there were also input screens for basic patient demographics, students, student teams, and the instructor. There were also a series of reports that were accessible through the text based menu system.

The prototype was supported with a set of data flow diagrams and an entity relationship diagram generated with the Visible Analyst Computer Aided Software Engineering (CASE) Tool. This strategy forced the student teams to document their prototype with commonly understood diagrams (Whitten, et al., 2004).

At the final presentation for the prototype, the PT faculty member was introduced to a local software developer, who provided feedback to the student teams. This particular developer, SoftTetra, had developed multiple interfaces for medical practice management applications on hand held devices, i.e., pocket PC's and tablets. Because one of the goals of the PT department was the use of handheld devices, this was of particular interest to the PT faculty member. The developer discussed the user interface that had been developed by the students, then commenced to discuss the difficulty in reducing an input form onto a hand held device, as Microsoft Access applications can consume considerable hardware resources which are dear on smaller devices. In addition, the developer pointed out interface issues such as multiple screens, as a small device must often scroll through 4-5 screens to access one input form on a tablet or notebook.

SECOND PROJECT

The first semester project in Spring 2005 involved the development of a prototype designed to store examination data for patients with knee conditions. This project evolved into a broader project for the second term, Fall 2005. No students were enrolled in both semesters SAD sections. During the second semester, the single class was provided with the prototypes developed in Spring 2005. However, their work involved the development of a prototype that addressed data associated with the more general examination process patients commonly referred to as an upper quarter screening examination. As with the students involved in the first semester's project, the

PT faculty met with the students and the instructor in the CIS classes in the second term to describe the clinic's documentation requirements, the types of patient data that needed to be collected and the current paper-based processes that were in common use. As with the first project, the PT faculty member also provided paper forms that PT students had developed on their own to facilitate collection of patient information during initial examinations to the CIS students. In addition, because the students were provided the prototypes developed in the prior term, they were able to discuss likes and dislikes of the prior semester's deliverables with the PT Faculty member. Two small groups of students, under the direction of the SAD instructor, each developed a DFD, ERD, using a CASE tool, and relational databaseprototype using MicroSoft Access which included one or more data entry forms and a variety of reports. When the projects were ready for the first deliverables for their project, the initial prototype and corresponding models, the students presented their work to both the CIS and PT faculty for comments and feedback.

An example of the input forms for the second phase of the project, produced for the final presentation can be seen in Figures 2 and 3. The form represented in Figure 2 illustrates the inputs required for initial neck assessment. Figure 3's form corresponds to some of the inputs that were identified in the Spring 2005 project, and correspond to the LQS, ROM, and MMT/CT screens accessed by tabs in Figure 1.

For the final presentation, the two teams presented their prototypes to both the PT Faculty member as well as the SoftTetra management. These professional software developers complimented the students on improving upon the prior semester's prototype with the use of more pull down menus and constraints of data values.

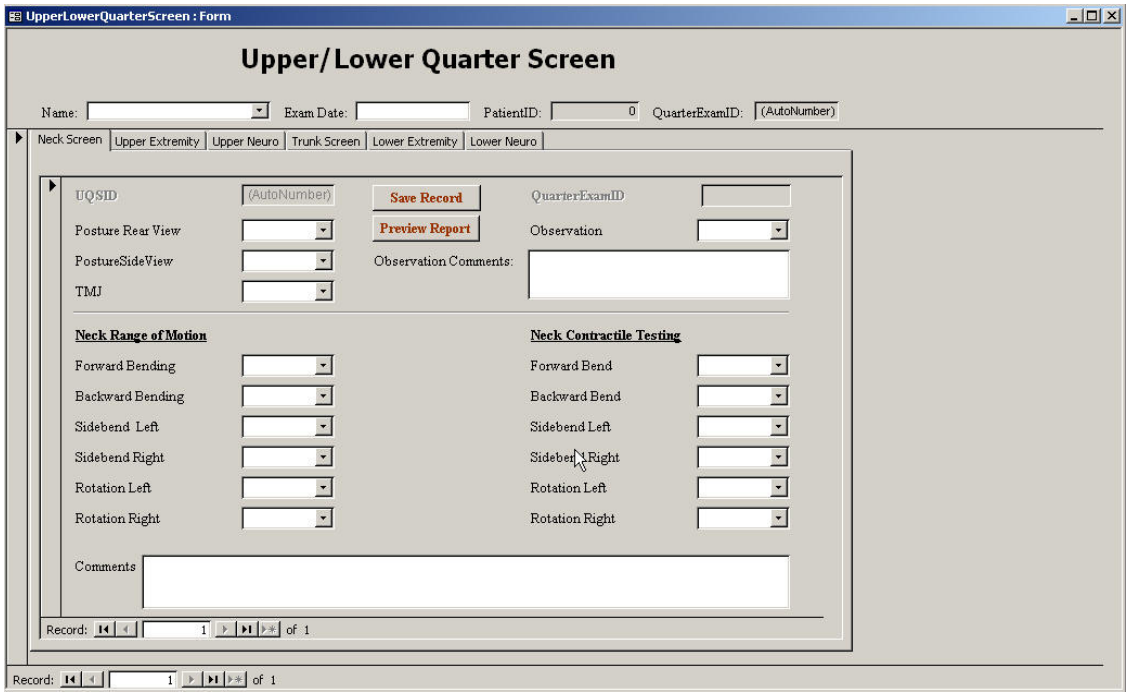

Figure 2. Upper/Lower Quarter Screen – Neck

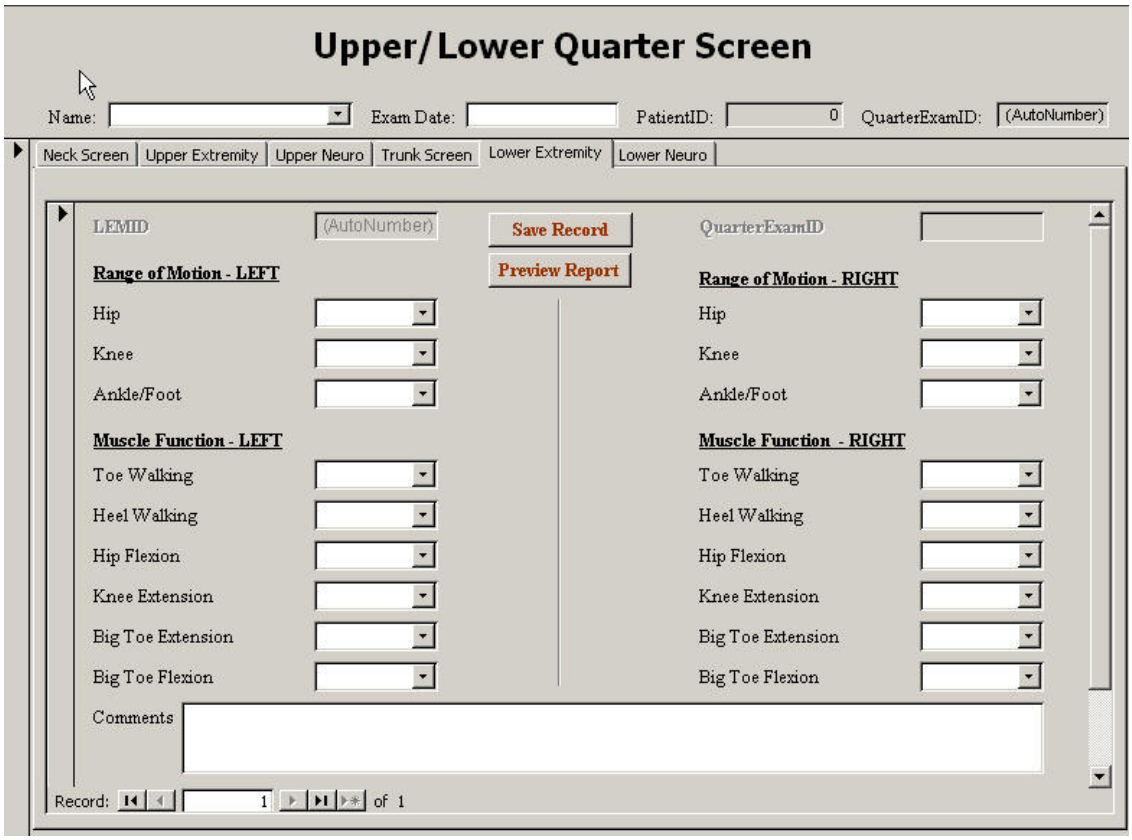

Figure 3. Lower Extremity form of Upper/Lower Quarter Screen

HUMAN COMPUTER INTERACTION

The use of prototyping and interactive design with the end user was performed throughout the collaboration period. This facilitated a set of 'commandments' noted for the development of an effective HCI. First, students were provided interviews, feedback, and documentation from the PT faculty member. Second, based upon presentations of the prototypes and feedback from the PT faculty member, the end user was heavily involved in the interface design. Third, the PT faculty member used the prototype between the two semesters. Finally, students practiced iterative design by moving between conceptual models and the prototype. Furthermore, inputs from the PT faculty member and requirements for course deliverables further reinforced strong HCI principles (Galitz, 1994; Whittten, et al., 2004)

The strong influence of the user, the PT Faculty member, further enhanced the following of HCI principles, addressing physical, perceptual, and conceptual design principles (Satzinger, et al., 2004). Furthermore, the forms created for inputs were designed based upon existing documents, another good HCI practice (Marakas, 2006)

V. BENEFITS AND DRAWBACKS

The project benefited the CIS students by providing them with a real-life example of a practical need to gather and analyze data. It also gave the students an opportunity to interact with a client during the development of a database prototype.

Based upon prior experiences with non-textbook or 'real' projects, it was the experience of the CIS instructor that a cooperative client with realistic expectations was critical for the students and the clients benefit. The PT Faculty member wholeheartedly participated in the interface design, testing the forms and reports, and providing feedback to the students.

The PT Faculty member also benefited from the interaction with the CIS students, because he was required to begin to think in more specific, concrete ways regarding the data he was interested in gathering and to produce a more detailed description of his data relationships and requirements. The collaboration also forced the PT faculty to

become more aware of the database's user interface and the appearance and utility of both the input forms and the reports. He particularly liked the use of tabs to keep input forms from becoming too large or unwieldy and he found that he also preferred the use of a database switchboard menu.

User inputs are critical in the designing of an acceptable information system. In addition, realistic expectations on the part of the user can also contribute to success in the evolution of the system prototype. On the down side, this is a demanding course on students. In addition to being introduced to data and process modeling techniques, they are also mastering a tool, Microsoft Access that can, at the minimum, allow them to quickly develop a proof of concept prototype for many organizational data collection needs. Furthermore, students are confronted with a loosely defined problem and with a client who is going through the initial process of stating and refining their data requirements. Also, because of the team nature of the project, they must also coordinate their activities at a group level, which further complicates their tasks in this course.

However, many students respond well to this demanding course load. Some students comment that they relished the opportunity to work on a real problem and to communicate with a knowledgeable user. Others found that by the end of the term, they were able to solve a problem that they believed was unsolvable a mere 10 weeks previous to the end of the term. Strong bonds also developed between the members of some teams, and positive team dynamics were both commented on by students and observed by the instructor.

VI. LESSONS LEARNED

While this project achieved, for the most part, its intended educational objectives, students at times felt overwhelmed by the unstructured nature of the assignment. The initial scope of the Spring 2005 project was too large. However, scope was minimized for the Fall 2005 project yet the students were still overwhelmed by project scope. The simple reassurance that client interviews reflect "real world" conditions and that actual

projects are not presented in summarized assignment form does not appease students who feel that they are in over their heads. In order to address student concerns and better prepare them, future project iterations will include more periodic deliverables, and more detailed lectures on data gathering prior to the meeting with the client. If the client and their application are associated with a specialized field, students will be instructed that researching that field will help them to better understand what is expected of a system in that industry, and also help them recognize and understand any specialized jargon used in that profession. Students will learn from first-hand experience that the old adage, "Prior preparation prevents poor performance," certainly holds true. Students should be advised to review in advance any available internal sources such as written documents, etc., as well as external sources such as textbooks and professional journals so that they can become familiar with technical terms and typical applications in that field.

Students should also be instructed on how to best conduct the interview with the client. First and foremost they must be sure that they understand what the interviewee is trying to tell them. They should not be embarrassed to ask for definitions or clarifications if needed. They should be advised in advance on the types of probing questions to ask, and should also be instructed to inquire if there are other users that they should interview.

Finally, students should be required to prepare an interview report immediately following the interview. The report format should require an initial summary, followed by more detail. In addition, students should be given the opportunity to review the report with the client.

Many analysis and design textbooks, such as the one by Kendall and Kendall (2004), include extensive details on data gathering techniques to which students should be introduced. Students must understand that the interview is only one approach to data gathering, and that observation, questionnaires, and even prototyping may be more appropriate in certain situations.

Aside from better preparing students for the data gathering phase, additional approaches for improving the project are under consideration. In many curricula the database class and analysis and design class use discrete projects, and students never have the opportunity to see a project through to its completion. While it may require additional coordination between professors, we would like to initiate a project in one class and continue it in the other, and also provide an elective class that would allow students to implement the project, or at least a selected-features prototype. Interweaving a single project throughout multiple courses will benefit the students by taking them through the development portion of the software life cycle.

One final lesson learned: using a university-based project helps to assure the receptiveness and availability of users. Prior "live" projects have been attempted with commercial entities, and while clients initially have a high degree of interest, that interest often wanes as the semester progresses and demands on their time make student interaction less of a priority. Working with clients associated with the university seemed to make a difference in both attitude and availability.

VII. FUTURE RESEARCH

Three separate but related PT efforts are also currently being considered, one of which proposes to use principles of data mining to facilitate clinical decision-making and thereby foster the incorporation of evidence-based practice in PT. The second effort aims to develop a data gathering and analysis capability that assesses the performance of student clinicians during patient encounters. A student performance assessment capability can be expected to benefit not only faculty in the ISU PT/OT Associates clinic, but also clinical instructors in off-campus clinics to which the DPT students are sent for additional clinical exposure. The third effort involves evolving a common set of data elements that would be portable among local practitioners, i.e. orthopedic surgeons, chiropractors, sports therapists, occupational therapists, etc. This effort would also potentially expand the data set to further assist in identifying evidenced-based PT practices. All these projects were conceived after the client became exposed to

systems development practices and the database environment, and unexpected outcome from the initial project.

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