Implementation and Management of an Information Systems Practicum in a Graduate Computer Information Technology Curriculum

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Abstract

This paper reports on the implementation and management of an Information Systems Practicum used in a graduate Computer Information Technology program. The Information Systems Practicum provides a student with an 8 month learning experience that is academically rigorous, intellectually challenging, and which serves as a culminating experience to the student's coursework. Specifically designed around an action research methodology, the Information Systems Practicum engages the student as a practitioner and provides real work opportunity congruent with the course of study. Implementation and management strategies, as well as the educational and philosophical foundations of the Practicum, are investigated along with providing conclusions about the program drawn over a 4 year period of time.

Keywords: Information Systems Practicum, IS practicum, action research, participatory research

1. INTRODUCTION

A typical conclusion to undergraduate and graduate study is a course that culminates all previous coursework and is generally formed in a "Capstone" course or "Professional Project". In the case of a graduate professional project, the coursework serves to engage the student in relevant project work that results in the documentation of an "applied" thesis. One viable option to the thesis or applied thesis that is presented in many programs is the Practicum. A Practicum is defined as: "work experience as part of study: a period of work for practical experience as part of an academic course" (Encarta, 2004), or as "a school or college course, especially one in a specialized field of study, that is designed to give students supervised practical application of previously studied theory" (American Heritage, 2004). This report details the implementation and management of an Information Systems Practicum in a graduate Computer Information Technology Program. Students in the program have the option of applying for one of fifty yearly seats in the Practicum and if accepted, work for a six month (plus two pre-requisite months of training) period of time to complete the Practicum and fulfill their requirements for a Professional Project applied thesis course.

Practicums provide valuable experience in developing and delivering Information Systems applications by assigning students to projects sponsored by "real" clients. Friedman and Friedman (1989) noted early on that obtaining practical experience is a major obstacle for new graduates. And

LaPlante (1991) found that most reputable Information Systems programs had graduates who would recommend internships or some other means of gaining practical experience. Practicums are specifically designed projects that have all the characteristics of typical Information Systems projects, including negotiated deliverables and schedules. Students work under faculty supervision, either alone or in teams. Past practicums have focused on corporate strategic planning, service-level agreements, telecommunications, imaging, pen-based computers, office systems, manufacturing, health systems, and decision support systems. There is ample support for the use of a Practicum as a teaching mechanism where theory and action can be combined to create reflective learning experiences (e.g. Eyssell (1999), Howerton (1988), Moynahan (1997), and Salleh (2002).

2. PROBLEM STATEMENT AND MOTIVATION

The design of the Information Systems Practicum was based on need. Three principle areas of need were motivating factors in how this Practicum was designed and prototyped in 2000. The business case for the Practicum centered on the teaching of the Database Technologies emphasis within the Master of Science in Computer Information Technology (MSCIT) Program. The university environment is a main campus with five extension campuses having individual local area networks where Oracle databases were installed to support the coursework in the emphasis courses. The university information technology services department was responsible for maintaining the local area network environments, but had no experience supporting Oracle databases. As a result, the local installations of Oracle on each of the six campuses experienced routine, unscheduled downtime and exposed students to unstable and frustrating lab environments for their coursework. Compounding the problem was a university plan to engage in distance education and offer the database emphasis courses to students online. Since the lab environments at the campuses were unreliable, a solution was put in place whereby students were provided with personal edition software on CD and instructed to do local installations of the Oracle database software on their home PCs. This resulted in faculty being required to support installation issues for students in their courses. These were ongoing issues. Consequently, no parties were satisfied with the solution. The university information technology services department could not adequately support the campus lab environments, the students could not easily install and configure the software at home, and the faculty took all their teaching time supporting student installation issues. There was a clear need for an Information Technology solution that called for a "win-win" among university services, students, and faculty.

3. ENTER THE PRACTICUM - DESIGN AND IMPLEMENTATION

The basic premise of the Practicum was to "employ" second year graduate students to support an infrastructure that could host the laboratory coursework needs of students in the MSCIT Program. Students submit an application and resume to the Practicum committee and are evaluated based on the merits of these documents. A written reference from two faculty members is also a required element in the application process. The implementation strategy called for the design and development of a "sustainable" support model, and a long term strategy to separate the host environment from the university network infrastructure. Additionally, the infrastructure would serve a dual purpose: a platform for students to complete required laboratory coursework, and an instructional platform for the Practicum experience. Design considerations included the use and high utility of existing infrastructure, and the use of action research as a principle teaching strategy. In 2000, five distinct phases of implementation began (Fig 1).

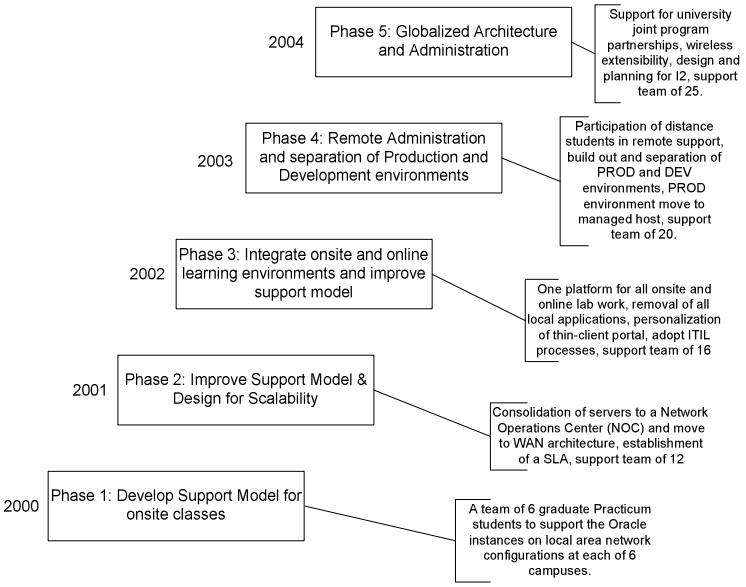

Figure 1: Information Systems Practicum Program Implementation Phases

To resolve the problem of lack of support for the Oracle lab environments, the Practicum was prototyped in 2000 with 6 MSCIT graduate students serving as Database Administrators (DBAs). Under the supervision and tutelage of the Lead Database Faculty, the students worked for a six month period to install and administer the Oracle databases, and support the students using the system. Each of the 6 campuses had one DBA assigned for support. The 6 month Practicum was completed between January and June. Job duties included installation and setup of the Oracle databases on the local area network, user account administration, and lab monitoring and support. Outcomes of the initial Practicum were measured through active support to the user groups, evidence of action research, and a final thesis report and presentation to faculty on the Practicum experience. With the success of the pilot Practicum in 2000, the program moved into the second phase of implementation in early 2001. The Practicums were scheduled in advance on a bi-annual basis. The "A" Practicum for the year was conducted from January through June, and the "B" Practicum for the year was conducted from July through December. The goals of the second phase of implementation were to consolidate the servers at the 6 campuses into one operational center. So the servers were moved from the individual campuses to the main campus where a NOC was established, and the local area network concept expanded to a wide area network concept. The initial Practicum pilot observed that additional manpower was required to service existing class needs and move the infrastructure forward. So in the second phase of the Practicum an additional 6 seats were added to double the strength of the Practicum workforce. With the additional students, better planning, coordination, research, and implementation occurred, as well as establishment and implementation of a Service Level Agreement (SLA) between the user community and the Practicum. In 2002 the University implemented plans to offer the MSCIT program in a distance education format. This complicated the Oracle lab support because there was no means for students external to the wide area network to access the labs. The architectural design solution was to integrate the onsite and online learning environments via a thin-client implementation over the Internet. This substantive change to architecture prevented the necessity for distance students to install Oracle locally on their PCs (and consequently create a huge installation support requirement on the part of the University) to complete their course work. Moreover, it simplified the architecture and support of the wide area network because Oracle clients were no

longer required on the wide area network PCs. Access to the Oracle environment was now centralized through the thin-client access model, and server management was centralized through the consolidation of the servers to the NOC. This phase of the Practicum implementation also saw the deployment of a web-based work order system so that a central queue for trouble tickets and work orders could eliminate the need for constant emails and phone calls. To better accommodate the need for communication flow, a Practicum Intranet site was created to serve as a repository for SQL scripts, meetings minutes, training materials, and other important communications. Phase 4 began in 2003 and included the move of the servers off of the University's wide area network to a co-location environment at an ISP. As demands on the servers increased there was not available bandwidth through the VLAN channels allocated to the servers through the University's wide area network. This phase of the Practicum implementation also saw the advancement of the practicum organization using the Information Technology Information Library (ITIL) framework. The ITIL framework created functional areas of support that are reflected in virtual teams. The functional support areas, known as Support Management Functions (SMFs), are identified as: Change/Configuration Management, Release Management, Incident Management, Capacity Management, Service Level Management, Availability and Security Management, and Documentation Management. By the 4th Phase of implementation, the Practicum staffing requirements had increased to 20 students. Remote administration of the servers is accomplished through Windows Remote Desktop technology, and remote administration of the Oracle databases is accomplished through SQL*Plus and Oracle Enterprise Manager (OEM), interfacing through a thin-client.

Phase 5 of the Practicum implementation began in 2004 and is focused on globalized architecture and best practices for 21st Century Knowledge Workers. The globalized support concept is being proven through the ability to create geographically dispersed virtual support teams that can provide a 24x7 support structure for MSCIT students world wide.

4. PEDAGOGICAL FOUNDATION

The concept of a Practicum has strong academic foundation. Health Sciences have used the Practicum concept for many years to engage students in real work experience as part of their curriculum. A similar concept is that of "Service Learning" where students engage in a beneficial project in a particular community for the purpose of applying skills and knowledge learned in the classroom. Practicum programs are generally designed with a curriculum, have structured activities, and measurable outcomes. Additionally, there can be a research ontology associated with the Practicum, such as quantitative or qualitative research. Associated epistemologies and methodologies are generally applied through the Practicum experience. The focus in this report is to provide an established ontology, epistemology, and methodology for the MSCIT Practicum, with a review of the pedagogy applied to conduct the Practicum. A strong pedagogical foundation can begin with establishing outcomes. In the case of this graduate Computer Information Systems Practicum, the exit competencies are stated as:

> Upon completion of the Database and Information Systems Practicum, the student will be able to demonstrate:
>
> - Knowledge of Oracle9i architecture, web-based implementation, and Jr. (entry-level) DBA administration
> - The ability to work within a virtual team environment
> - The ability to work with web based tools in a community of practice
> - Synthesis and evaluation of content at a graduate level
> - How Knowledge Workers are evolving in the 21st Century
> - Global host architecture for accessing an Oracle9i database
> - The impact of future technologies and concepts in IT

- Evidence of graduate level research, publishing and presentation skills

An essential pedagogical element of the Information Systems Practicum is teamwork. Student participation is measured through attendance at required meetings, accomplishment of assigned tasks, active engagement in all team activities, and production of a final (applied thesis) report. The advantage of teamwork in the reflective learning process associated with action research is supported in many previous practicums initiatives. Walker and Slotterbeck (2002) report on the success of using teamwork in software engineering curricula, and Trevisan (2004) notes the advantage of using group (team) work. Moreover, Trevisan (2004) notes that reflection within the team framework is fundamental to adult learning. There is ample literature to support techniques for facilitating reflection, collaboration and communication within the Practicum (e.g. Clarke (1995), Coker and Schrader (2004), and Wu and Lee (1999). The pedagogical foundation for practicums is further supported by Buckley, Kershner, Schindler, Alphonce, and Braswell (2004), who report on the efficacy of designing technology (computer science) courses that result in high levels of student comprehension, internalization, and retention. Their work indicates that projects should take place in real-world experiences, have a rich environment available, offer many solutions to the problem presented, and have academic evaluation the builds upon previous learning. All this can point to the value of using practicums as a means to advance student learning in Information Systems programs.

The ontology applied in this Practicum is that of a qualitative research study. The underlying epistemology of the qualitative study is that of interpretive research, with action research being the primary research methodology. Action research is becoming an increasingly active part of information systems research. The general form of the action research is that of intended action-reflection-planning-action. Students engage in some action as determined by the needs of the users, the systems being supported, or the strategic infrastructure goals of the Practicum. After completing the action, the student formally reflects on the action and the outcomes, successes, and failures of the outcomes and uses this information in the planning process for the next plan of action.

Action Research in Information Systems –Working in the Practicum

A goal of action research is to have both an action and a research outcome. Students will initiate an action based on some planning or intention associated with a specific goal. The goals are mapped to workflows that are iterative in nature and correspond to various support roles. The ability to be responsive in the action research is one of the primary motivations for using a qualitative method. Another quality of action research that lends well to the Practicum experience is the requirement for student participation in the action research. Action research also lends itself well in work or community situations. In the case of the Practicum, students work as agents of change and can use the actions as part of their assigned activities. Action research serves as a research method that can be easily integrated into practice. According to Kolb (1984), the action research cycle can also be viewed as a learning cycle. And educators (e.g. Schon, 1983, 1987) will hold that a method for systematic reflection creates a solid environment for students to learn. Action research subsumes a variety of research approaches, and is thus an ideal paradigm for an Information Systems Practicum. Generally, the various approaches use a variety of methods for planning, information gathering and interpretation (note the treatment of action research by Patton (1990), Checkland (1981), Susman (1983), Argyris (1985), and Carr & Kemmis (1986). Thus the action research methodology for Information Systems can be formed from various empirical methods and research methods including the social context of the problem, direct observation, interviewing, application of theory, and interpretive analysis. So the rigor of action research is comparable to all other qualitative research methods. The action research most often will start off with pondering a fuzzy information systems question or problem,

and successive iteration yields a clearer and clearer view of the question or problem. Lewin (1948) proposed early on that learning and change can mutually enhance one another. Since the purpose of action research is to learn from experience and then apply the learning to future change, the dynamics of action research in an Information Systems social context are readily apparent in times of change. The Information Systems action research methodology for this Practicum is illustrated in Figure 2.

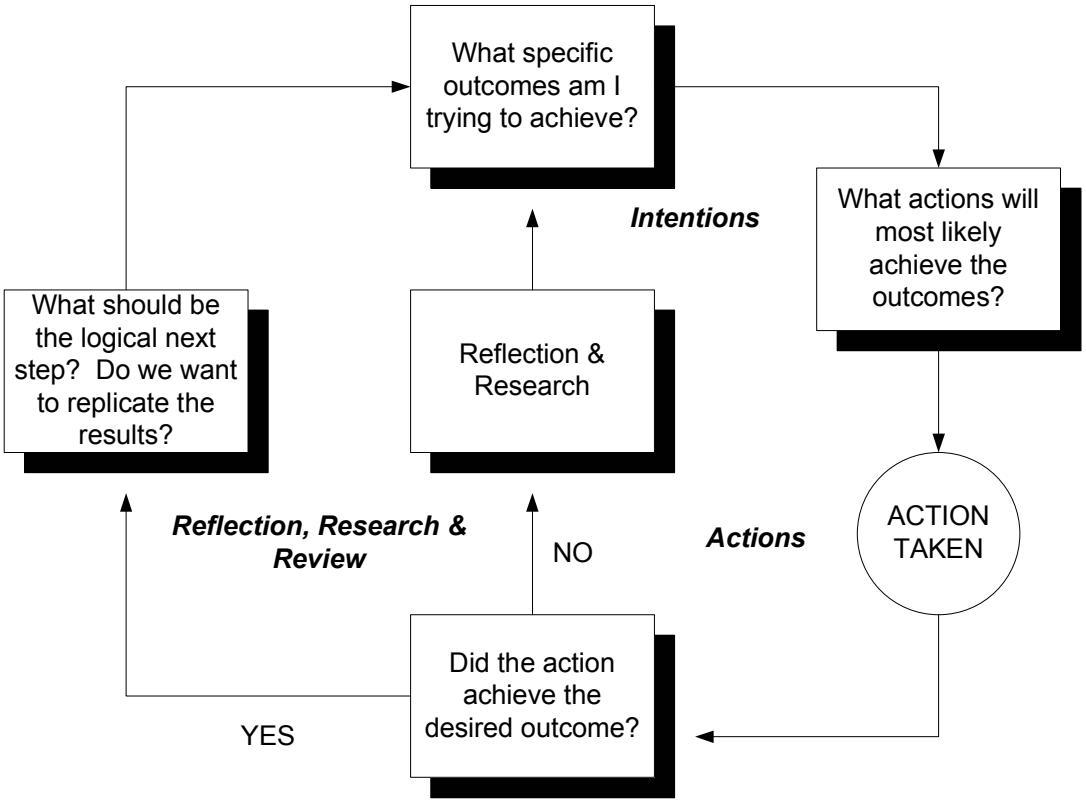

Figure 2: Information Systems Practicum Action Research Methodology

The cyclic nature of the action research is to start with some intention or intended outcome. An action is planned and then taken with an evaluation of whether or not it met the desired outcome. If it met the desired outcome then logical next steps are determined and appropriate next step outcomes are articulated. If the desired outcome is not met then the student will reflect and do additional research to once again state an intention or intended outcome. This creates the next iteration of the cycle. According to O'Brien (1998), "…action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to further the goals of social science simultaneously. There is a dual commitment in action research to study a system and concurrently to collaborate with members of the system in changing it in what is together regarded as a desirable direction. Accomplishing this twin goal requires the active collaboration of research and client, and thus it stresses the importance of co-learning as a primary aspect of the research process." So in this Practicum action research is used in real situations and primarily focused on solving real problems.

5. MANAGEMENT AND OVERSIGHT

The organizational structure and management of the Information Systems Practicum is modeled after the Information Technology Infrastructure Library (ITIL) Process Model. ITIL is a widely known collection of best practices, activities, and associated metrics and tools that allow an IT organization to systematically plan, develop, deliver, and maintain services to end users and customers. Optimal service management in an IT organization can be achieved through application of the ITIL concepts and standards. With a prime directive to support the business environment through proper application of the IT infrastructure, the ITIL model framework focuses on servicing end user needs, constructing a process foundation for IT practices, and organizing IT organizations for optimal service. The Information Systems Practicum models the core process areas from the ITIL structure and provides for operational support in the areas of incident management, problem management, change management, release management, configuration management, availability management, capability management, security management, and service level management. Many Fortune 1000 companies adapt the ITIL Model to their particular needs. For example, the Microsoft Corporation utilizes an adaptation of the ITIL Model known as the Microsoft Operational Framework (MOF). Thus the Information Systems Practicum program adapts the ITIL Model to accommodate the needs of the Practicum's organization and management. The ITIL process aligns easily with Total Quality Management (TQM) initiatives and other process engineering standards. Figure 3 illustrates how the Information System Practicum implements against the ITIL Model.

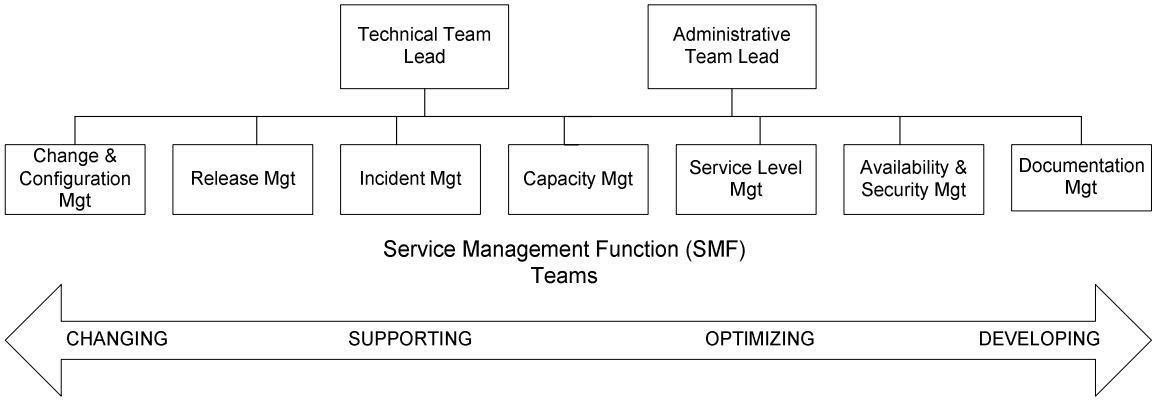

Figure 3: Information Systems Practicum Organization Chart

Students are assigned roles in this organizational hierarchy based on background, experience, course work, degree emphasis, and personal interaction. A senior faculty member generally manages the Practicum organization and is responsible for oversight, training and initial organization. The two lead students manage the general flow of activity and conduct the monthly Practicum meeting. The SMF Team Leads serve as project managers for various projects associated with the Practicum, and also provide team leadership within their individual teams.

6. RESULTS AND CONCLUSIONS

The MSCIT Practicum is currently moving into its 5th year of operation and is working to achieve a state of maturity. The Practicum program is in high demand among the student population as the reputation of the program has become common knowledge. Objectively, the Information Systems Practicum offers students with a viable alternative to a professional project or capstone program by engaging them in action research methods over an extended period of time while providing real work experiences. Additionally, the Practicum program serves as a conduit to explore 21st Century

Knowledge Worker skills and proficiencies in a non-threatening learning environment. The use of various web based tools and applications to engage in remote administration, application support, server maintenance, and database administration provides the student with real world job experiences within the framework of an academic research problem. The participatory nature of the research allows the student to not only view the technical aspects of Information Systems work, but also study the social context of the work through an Interpretivist epistemology. Using this relevant research methodology to conduct a qualitative study and report provides the student with a robust experience in graduate level research design and implementation. An additional result is the valuable experience gained by working within the ITIL framework. Besides the organizational techniques of virtual teams, communities of practice, and remote administration, the ITIL framework provides the student with an inside view of how Information Systems organizations can function and optimize. The Information System Practicum concludes with a final written graduate level report and presentation to faculty on the Practicum experience. Treated as a thesis defense, the student delivers a formal presentation and engages in defense of their work through questions from a faculty panel. Clear evidence of graduate level written and verbal communication skills, clear and ordered thinking, higher level cognitive abilities, and social and academic contribution must be presented in the defense.

Lessons learned through the Practicum experience can be articulated in five sentences:

1. Ensure that the institution and program have a complete understanding of the application of action research in support of applied learning.
2. Implement a strong student-lead organizational structure in order to properly manage the daily operations of the Practicum.
3. Continually reinforce the objective of using 21st Century Knowledge worker skills, methods, and tools to accomplish the goals of the Practicum.
4. Allow the Practicum to be a fluid concept and organization that responds to the needs and challenges of the program.
5. Hold Practicum members accountable in their roles just as any business organization would expect accountable from its employees.

The conclusion of this paper is that the Information Systems Practicum takes a large amount of individual faculty and institutional support and dedication, but results in a valuable learning experience for the student. The concept of a Practicum is not new, but is a tested and valid method of enhancing educational experiences, especially in applied sciences. As such, it is particularly well suited to the Information Systems field of study.

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