

INNOVATION IN THE IT CURRICULUM: A CASE STUDY IN INFORMATION TECHNOLOGY LEADERSHIP

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ABSTRACT

In an age of continuing outsourcing and reorganization of Information Technology (IT) related jobs, colleges and universities are faced with an urgent need to adapt their educational offerings in order to better prepare students for the types of IT employment opportunities for which they will compete upon graduation. This paper examines the case of a new major in Information Technology Leadership, developed beginning in 2001 at Washington & Jefferson College—a small, private, co-educational institution with a strong focus on the liberal arts and sciences, located near Pittsburgh, Pennsylvania. Findings of this case study show promising results after four years of operation, including the development of three areas of emphasis within the major, enrollment growth across all emphases, and positive post-graduation results for students.

Keywords: Information Technology, Leadership, Data Discovery, Information Systems, New Media, IT Education

INTRODUCTION

This paper presents a case study of the design, development and delivery of a new major in Information Technology Leadership (ITL) at Washington & Jefferson (W&J) College. The study shows an academic response to the fallout from what has come to be known as the dot-bomb. This period following the year 2000 is characterized by an increase in the number of bankruptcies and contractions of companies involved in high-technology (especially those related to the Internet and eCommerce), coupled with an increase outsourcing and restructuring of IT-related jobs such as technical support, help desk functions, front-line programming, and technical quality assurance [3, 5]. Fears surrounding future employment have led to a decrease in enrollments in Information Systems and Technology departments at colleges and universities throughout the United States [2, 9, 11].

In the face of these new conditions, W&J College began a unique and intentionally designed project in

2001—the development of an ITL major. Without a previously existing IT major at the college, this new major was grounded from the beginning in an awareness of the post-boom IT climate. Our belief was that the future of IT-related employment in the United States would continue to demand the use of information technology as a tool across many professional and academic disciplines [5, 8]; however, future jobs in these areas will demand college graduates who are prepared not only with quality technical skills, but also with experience in leadership, critical thinking, decision making, and organization [7, 8]. We therefore set out to infuse elements of leadership into a highly flexible curriculum which enables students to receive a broad-based IT education while gaining and improving leadership skills essential in today's IT employment environment [6, 7, 8]. This study reflects on the past four years of development in the ITL major, including the structuring of three areas of emphasis available to students within the major: Data Discovery, Information Systems, and New Media.

RESEARCH METHODOLOGY

Consistent with the mission of W&J College, the vision for the ITL major was to develop a highly interdisciplinary and complementary curriculum which would encourage students to gain a broad range of knowledge before choosing an area in which to specialize. Details of our program design, implementation and evaluation are outlined in this case study.

Data Collection

The Information Technology Leadership program was designed to instruct students in core technology principles in a liberal arts context. For us, this meant treating IT as a fundamentally interdisciplinary field, putting interdisciplinary connections at the forefront of the curriculum. Individual courses often highlight connections to particular complementary disciplines, while the three emphases focus on different classes of tools that IT can provide for the whole breadth of disciplines students might pursue. The data presented here represent trends and observations collected over the first four years of the program including

enrollment figures, distributions by gender and graduating class, and student evaluation data.

Student Profile and Details of Coursework

W&J College is an undergraduate institution with a highly traditional and residential student population studying full-time. Students can choose to double major or minor in ITL in order to complement their study in another field.

Consistent with figures and trends concerning gender distribution in computer technology, the percentage of women majoring in ITL is relatively low (approximately 13%), with the highest proportion of those women choosing the New Media emphasis within the major [4, 11]. Within the minor, which does not require an emphasis, about 22% of the students are women. Table 1 illustrates these distributions in greater detail.

Table 1. Gender Distributions of ITL Majors and Minors by Graduation Year

Year	Male Majors	Female Majors	Male Minors	Female Minors	Total Majors	Total Minors
2004	3	0	2	1	3	3
2005	10	1	2	2	11	4
2006	7	1	5	3	8	8
2007	12	3	10	1	15	11
2008	17	2	6	0	19	6
2009*	4	0	2	1	4	3

* At the time of this writing, the class of 2009 are current freshmen who are not encouraged to declare a major or minor. The figures for the classes of 2008 and 2009 are expected to increase as the younger students declare a major or add a minor.

Students are required to complete 44 semester hours (11 courses) of work for the major. This comprises approximately one-third of the courses required for the bachelor’s degree at W&J, encouraging students to use the other two-thirds of their coursework to add breadth and depth of knowledge in diverse disciplines. All students majoring in ITL must complete six core courses and five emphasis courses (Table 2).

The ACM and IEEE have been driving forces in developing model computing curricula over the past five years, and their most recent guidelines offer a snapshot of a traditional IT core curriculum, shown in Table 3 [1]. Within these guidelines, the field of Information Technology is described as “focus[ing] on meeting the needs of users within an organizational and societal context through the selection, creation, application, integration and administration of computing technologies” and sets a primary aim of IT programs as “provid[ing] IT graduates with the skills and knowledge to take on appropriate professional positions in Information Technology upon graduation and grow into leadership positions or pursue research or graduate studies in the field.”[1] In contrast, the ITL program has been designed to avoid presuming a particular career path or post-graduate goal for majors in the program. With the growing integration of technology into every field of endeavor, we work within W&J’s liberal arts curriculum to produce graduates who can understand the use and impact of technology across society.

Table 2. Required Core Courses for ITL Major

- ITL 100: IT & Society
- ITL 102: Introduction to Programming
- ITL 201: Database Concepts
- ITL 301: Human-Computer Interaction
- ITL 400: Service-Learning Capstone
- PSY 101: Introduction to Psychology

Design

From its inception, the ITL program was designed to have both a core that instilled all students with strong leadership skills in technology, and to have three complementary emphases covering the breadth of contemporary IT: Data Discovery, Information Systems, and New Media. These emphases were shaped in part by looking at curricula at other institutions; however, it is worthwhile to note that the ITL program was not developed with an intention to pursue ABET or AACSB accreditation. Thus, while the program was developed with an awareness of their requirements, we were free to deviate as necessary to achieve our specific goals.

These differing underlying assumptions about the purpose of an IT versus an ITL major are reflected in the core curriculum suggested by the ACM versus that developed at W&J for the ITL major. The five courses in the left column of Table 3 correspond to the five core courses in an ITL major (shown in Table 2). These courses ensure that students have grounding in the problem-solving methodologies of the field, appreciation for the historical, social, and

ethical context of information technology, and preparation to be leaders in any field they pursue, with their IT skills serving as a one tool they can employ. The required service-learning capstone course enables students to engage the leadership principles they have been learning in an applied

setting, while also providing hands-on experience in IT.

The first three courses listed in the right column (denoted by [§]) correspond to emphasis courses within the ITL curriculum.

Table 3. ACM Recommended Core Courses for an IT Major

<ul style="list-style-type: none"> ▪ IT Fundamentals – History & Background ▪ Programming Fundamentals ▪ Information Management & Databases ▪ Human Computer Interaction ▪ Social & Professional Issues 	<ul style="list-style-type: none"> ▪ Web Technology[§] ▪ Information Assurance/Security[§] ▪ Networking[§] ▪ Platform Technologies ▪ Integrative Programming ▪ System Administration & Maintenance ▪ System Integration
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Each of these technological fields forms a basis for interdisciplinary uses of computer technologies. Web technologies are pervasive in information distribution and collection; the social and ethical problems of computer security are among the most pressing in the field today; and networked computing lays the groundwork for current innovations in communication and collaboration and points the way towards the future of high performance computing in the sciences and business. The final four courses in the ACM recommended core do not correspond to specific offerings in the ITL program, though some elements of these courses are taught in available elective courses. These latter four courses are the components of a traditional IT major which are most relevant to “professional positions in Information Technology”, and which do not have obvious interdisciplinary applications. Instead of requiring extensive coursework geared towards professional training or certification, majors in ITL select an emphasis within the program around which to organize their upper level courses. These emphases enable strong connections to the broader W&J curriculum. For example, upper-level offerings from the three emphases include Geographic Information Systems in Data Discovery, Computation and Cognition in Information Systems, and Digital Film in New Media. By leaving more options at the upper levels, students are encouraged to connect their work within the major to their other academic experiences, thereby preparing them with the broad and well-rounded education that informs the mission of a liberal arts college. Courses in all three emphases include exploration of the unique leadership issues within their context as a fundamental component of course content.

Implementation

Fundamental to the implementation of the ITL major is the construction of three complementary emphases. These emphases allow students to investigate a particular approach to IT in depth. Majors are required to take three courses within some single emphasis, with at least two of those courses being at the 300-level or higher. The emphases each have strong, unique interdisciplinary ties.

The New Media emphasis was the first fully-developed emphasis in the ITL program. Students in the New Media emphasis focus on how we communicate meaning through innovative contexts capitalizing on various new media such as static and multimedia web documents, digital images, and digital video and audio. Visual literacy and creative problem solving are stressed; students are asked to reflect on their consumption and critical understanding of new media content. A wide range of fields are drawn from, including graphic design, educational technology, film studies, media studies, digital photography, human-computer interaction, electronic publishing, project management, and multimedia production. The interdisciplinary connections of this emphasis are strengthened by the cross-listing of many of the courses in this emphasis with a Graphic Design Concentration, open to students of any major wishing to study the theory and production techniques pertaining to graphic images of any form.

The Information Systems emphasis has also been in development since the initiation of the ITL program. Students in the Information Systems emphasis focus on how we collect, represent, and work with diverse

information in the presence of information technology. They are encouraged to ask themselves how technology informs our information usage and problem solving processes. This question often asks them to reflect on our own innate information processing capabilities and consider what we can learn from them. They are also asked to consider how technology impacts the security and privacy of our information and the need to integrate technology into our society in a manner consistent with our underlying principles and values. There are strong interdisciplinary connections to Psychology, Philosophy, and the college's Mind, Brain, and Behavior program from within the Information Systems emphasis.

The Data Discovery emphasis is the most recently developed emphasis, with initial course offerings beginning in January 2005. Students in the Data Discovery emphasis will focus on the ways that computers can help humans understand complex social behaviors or scientific phenomena. In addition to learning how to acquire data for digital manipulation, students will learn how to access large datasets for specific purposes, and to convert that data into human-useable form. Students are encouraged to connect these skills to interests in a related minor or double major in a science or social science field, using the techniques of data analysis, data mining, or geographic information systems to enhance their broader educational objectives.

Together, these three emphases support connections to the arts, the natural sciences, the social sciences, and the humanities. Including two electives drawn from any emphasis in the major requirements allows students to customize their ITL coursework to their particular interests while still ensuring a depth of study in at least one area. In particular, each of the three emphases has a 200-level introductory course, surveying the emphasis. Students are able to count two such courses towards the major, allowing them to sample more than one emphasis before deciding on a path through the major. It is anticipated that students will supplement an emphasis in one of the two areas with offerings from the other, as suggested by their ultimate academic interests and career goals.

Evaluation

At the outset, several goals were established for the ITL program. Although the program continues to develop and evolve as of this writing, the examination of these goals in the context of what has been accomplished thus far is beneficial in determining the degree of success the program has

enjoyed while identifying areas where improvement or future opportunities await.

The preparation of the coursework needed in order to offer all three emphases was a primary objective of the initial phase of the program. Several new faculty hires were required to prepare and offer these courses, and to advise students who would enter the program. Increased student enrollments in ITL courses, and numbers of declared majors and minors would indicate success as well. Finally, measures of student satisfaction through course evaluations and post-graduation feedback, employment offers, or graduate school work would help to determine the perception, acceptance and success of the program as it relates to those for whom it was designed.

FINDINGS

The ITL program began with a single faculty member in the 2001-2002 academic year. Two additional tenure track faculty were added by the beginning of the 2003-2004 academic year – one to develop the Information Systems emphasis and the other to develop the New Media emphasis. It was in this year that ITL saw its first majors graduate. These tenure track hires enabled the department to develop new courses and to attract and advise additional majors and minors in the program, leading to continued growth. Budgetary constraints delayed the hiring of the fourth full-time faculty member, focusing on Data Discovery, until the 2005-2006 academic year; however, this position has recently been filled and the emphasis will now be available to students who will be graduating in the 2006-2007 academic year.

Figure 1 indicates trends for students with a major or minor in ITL, while Figure 2 illustrates students enrolling in ITL courses regardless of major.

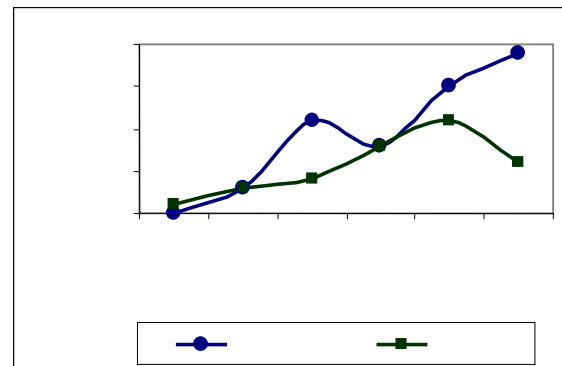


Figure 1. ITL Majors & Minors Graduating by Year

Several ITL courses, including ITL 100: IT & Society, and ITL 201: Database Concepts, enjoy substantial enrollments by students who are interested in the course topics but who are not pursuing a minor or major in the program. While enrollment numbers for the 2005-2006 year may appear to be flattening out or slightly declining in Figure 2, it should be noted that the ITL department has one faculty member currently on academic leave, thus reducing the absolute number of student seats available in the latter half of the academic year. Overall course enrollment trends continue to be strong.

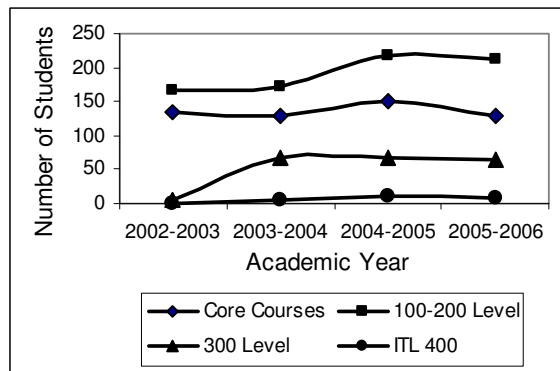


Figure 2. Number of Students Enrolling in ITL Courses by Year and Course Level

Other measures of success also indicate a promising future for the ITL program at Washington & Jefferson College. A sample of 92 course evaluations from seven completed ITL courses shows high student satisfaction with courses. On a 10 point Likert scale, students averaged a response of 7.99 when asked the question “How much did this course contribute to your general education”. Even restricting our attention to 100 and 200 level courses which have no prerequisites and have the highest population of non-majors, the average student response was a 7.72 on the same question. Underscoring our desire to prepare graduates to use IT in whatever professional path they pursue, several former ITL students are now enrolled in master’s degree programs at schools including Carnegie Mellon University and the University of Pittsburgh, while others have gone on to start their own small businesses.

CONCLUSION

In the face of declining IT-related enrollments at colleges and universities nationwide, the ITL

program was launched in a challenging climate. Some incoming students (and their parents) at W&J have voiced concerns over the aforementioned issues of IT outsourcing and workforce reduction. We have consistently responded to these concerns by highlighting the unique program design which seeks to prepare students with an appropriate level of skill, while also equipping them with the critical thinking and leadership skills necessary to succeed in any career they choose. As the ITL program at W&J continues, we anticipate continued growth as students, faculty and administrators capture the vision of fusing concepts of a liberal arts education and leadership with a model IT curriculum in order to meet the changing IT needs nationwide.

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