A QUALITATIVE STUDY OF STUDENT PERSPECTIVES AND EXPERIENCES IN AN INFORMATION TECHNOLOGY EDUCATION PROGRAM

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DISSERTATION

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ABSTRACT

The purpose of this study is to learn about students' perspectives of an undergraduate level information technology (IT) education program. The IT program is a recent effort to create a new educational opportunity for computing in college, with recognition that the recent IT developments have had a greater influence on various aspects of people's lives than ever. Students' perspectives are a necessary piece of information to develop this innovative IT education program into a sound educational opportunity. Data were gathered through qualitative in-depth interviews conducted with 28 undergraduate students, most of whom have taken one or more IT classes before. The interview data were analyzed using the grounded theory approach.

The analysis found that college students perceived that they were very competent in dealing with IT primarily due to their continued exposure to computers since youth. However, this perceived competency was not very stable. Students felt that they did not have sufficient IT competency when technical skills of dealing with IT came to attention. They also felt so when comparing their IT competency with that of their peers, examining it in a class context, and confronting a transition from education to the real world. In spite of their preference for and confidence in self-guided learning, students wanted to receive a formal instruction in IT when they needed to learn something difficult, something that they were not very interested in, and something important for their future lives. They also expressed a desire to gain a comprehensive understanding of computers without needing to learn fundamental computing principles.

Students' various interests in IT education were dispersed around learning practical technical skills and understanding social implications of IT. Many participants' focus was a mixture of the two factors, which was often expressed as an area that dealt with "how humans and computers interact." This blended interest suggested a potential defining characteristic for IT education. Students' motivations for pursuing IT education ranged from their passion to some practical considerations. The majority of students expressed mixed motivations, often more strongly inclined to practicality. This finding implied that students' practical considerations as well as their pure

interests were an important factor to consider in administering an IT program. Participants found that the primary value of the IT program was that it incorporated technological and social topics which had not been well connected previously. Yet, balancing the technical and non-technical components in the curriculum also proved to be the most controversial aspect. Students perceived that the weaknesses of the IT program were also associated with its interdisciplinary nature. Students also viewed that the topics in the IT program were more closely related to many real world problems than the curricula of typical college education programs. Finally, the analysis revealed that students determined the value of the IT minor program in relation to their majors and career interests. Students took the IT minor to supplement their majors, in terms of their interests in developing their careers beyond formal education.

Overall, this investigation showed that students perceived this broad-based education program for IT as an intermediate field that filled a significant niche in college education caused by the recent technological innovations: between technical and social, between school and everyday life, and between formal education and the "real world." The results have practical implications for the development of IT programs in college and for future research directions.

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1. INTRODUCTION

1.1. Emerging IT Programs in U.S. Colleges and Universities

Recently, a number of new information technology (IT) education programs have emerged in U.S. colleges and universities, in addition to the traditional computer-related education programs such as Computer Science (CS), Computer Engineering (CE), and Management Information Systems (MIS). The new IT programs are being identified with titles such as Information Science, Information Systems, Information Technology, or Informatics. These programs have been developed on the basis of the recognition that there is a significant niche between studies of technologies and those of the various contexts in which the technologies are situated, in terms of research and teaching. Many of these programs are found at both graduate and undergraduate levels.

Broadly, many IT programs are still in an early stage of development and do not share a well agreed-upon identity. Many of the programs started to emerge only recently, and are still in an immature stage. Subramaniam (2005) acknowledged the year 2001 as the start year of IT programs in U.S. colleges and universities, when the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) Computer Society organized a joint task force to develop the Computing Curricula 2001 where a new IT curriculum was documented along with four other computing curricular. Abbott (1995) mentions that the emergence of a new field is frequently fluid, inchoate, and diversely defined until the process of self organization matures. In a nascent stage of development, the new IT programs may well be undergoing a dramatic transformation. The identity of the programs still remains unclear, and their nature and scope are still being debated intensively.

These programs' interdisciplinary nature also makes their identities blurry. IT no longer denotes specific-purpose technologies. It is becoming the general infrastructure upon which many social/organizational processes are built. Therefore, deployment of IT always accompanies complex contextual issues, which spans social, economic, legal, and ethical issues. To address the complex issues that span both technical and social fields, universities often call for a collaborative endeavor from different disciplines to organize

an IT education program. The interdisciplinary collaboration is structured differently across institutions. Some schools have organized their IT programs mainly among several traditional computer-related fields. Other schools have organized their programs based on collaboration among more widely dispersed disciplines, as diverse as Communications, Biology, Art, etc.

However, most new IT programs commonly include the word "information" in their program titles. It signals that those programs' focuses are on information rather than technologies themselves, which is the major product of the rapidly evolving computing technologies. The common focus on information may be an indication of the IT programs' potential identity, which distinguishes them from other pre-existing computer-related disciplines. The centrality given to information suggests that the emergence of the new IT education programs reflects the heavy pressure placed on higher education by the stakeholders in the knowledge economy.

In the knowledge economy, information and knowledge, rather than tangible material resources, have become the primary economic resource. Cortada (1998) points out information technologies have existed in various forms in history. All the technologies used for processing, storing, and transporting information are information technologies, but IT in the current sense generally indicates networked computer systems that produce and process information in a digital form (Carr, 2003; Freeman and Aspray, 1999). The share of knowledge workers has grown with the introduction of each new information technology (Cortada, 1998). However, many historians and economists generally agree that the growth of knowledge workers accelerated in the 1990s, with the explosion of computer technologies, more specifically with the introduction of the Web technologies (e.g., Wolff, 2005).

As computer technologies have become the primary medium to generate, deliver, and exchange information, the abilities to use knowledge and information cannot be separated from some level of understanding of the modern information technologies. Therefore, understanding of modern information technologies is necessary for anyone to obtain the abilities to handle knowledge and information proficiently to their needs. The increasing importance of human capabilities in dealing with knowledge and information is placing

higher education at a more central position in educating young adults. The emergence of the IT education programs in colleges seems to be closely associated with the growing stakes arising in this knowledge economy.

Many schools have developed IT programs both at undergraduate and graduate levels. Currently, there are more graduate programs than undergraduate programs. For example, the i-School Caucus, one popular group of schools that offers the new type of computing education programs, was organized mainly by schools that have had graduate programs in Information Science. Graduate programs are still the majority for various reasons. Among the 21 i-Schools, one third of the programs do not have an undergraduate degree program as of the fall of 2008. The other i-Schools have an undergraduate program but tend to have a different name for their undergraduate program from that of their graduate programs. This indicates that the focus of the undergraduate curriculum may be different from that of the graduate curriculum. For example, one i-School teaches a lot of business components in the undergraduate program; whereas another i-School teaches technical computer skills such as networking technologies and databases in its undergraduate program. However, neither of their graduate programs has a specific emphasis on business issues or technical skills. It seems that undergraduate IT programs are being established and administered by different forces from those of graduate IT programs.

In spite of the confusion, there are reasons that schools are increasingly interested in building an undergraduate program in IT. Unlike the earlier days of computing where only a few people interacted directly with computers, an increasing number of people are doing so (Snir, 2008). Therefore, many scholars and practitioners recognize that computational thinking, a concept that centers around the ways in which computer scientists would frame and solve various problems, should be taught to diverse populations as an important part of basic literacy, along with reading, writing, and math (e.g, Wing, 2006).

Many studies on the digital divide commonly point to the fact that people's age and education level are two main factors that make a difference in their computer use (e.g., National Telecommunications and Information Administration, 1999). Younger generation people tend to use computers more frequently and intensively than older

generation people; also, the higher an individual's education level is, the more access to computers one has. Therefore, college students have been considered as one of the most important user groups. In addition, higher education is the major source of supplying manpower that has the capability to innovate and embody new ideas and knowledge for the current economy where information technologies are increasingly incorporated into its various functions (Pyoria, 2005). These considerations have been the conceptual foundation upon which the IT programs targeted at college students were built.

When undergraduate education becomes a focus of interest, the issues involved are different from those of building a graduate program. Graduate education means different opportunities and educational paths. A graduate program typically has a narrower focus, with greater depth through coursework, research, and/or practical experience, than an undergraduate program has. Students often consider graduate education because they want to seek their interests in depth in a particular field, or to pursue a career that requires an advanced degree. Graduate students tend to be more professional and have clearer career orientation in specific fields. However, this professional orientation may not be as applicable to undergraduate students. Therefore, the focus of an undergraduate IT program may well be different from the focus of a graduate IT program.

Another factor that makes issues involved in undergraduate IT programs complicated is a strong connection between education and employment, which reinforces many practices in higher education to be administered with relation to occupational classifications. Snir (2008) argues that the professional orientation often coupled with accreditation systems tend to reinforce existing practices, not to promote new practices in universities. His point implies that this strong existing bond between academic disciplines and occupational classifications would hinder the building of an interdisciplinary program that covers a broad range of issues across many disciplinary areas.

1.2. Limitations of Previous Studies on IT Education

Existing studies of IT education have not sufficiently addressed those complex issues involved in building the undergraduate IT programs. First, many existing studies focus on

their graduates' employment prospects in the IT sector. Although emerging IT programs have a broader scope and are addressing broader goals than those of the traditional computing fields, many existing studies still tend to have a narrow focus of the IT job market.

Employment concerns are most obvious in the IT programs organized mainly by traditional computing fields (e.g., Denning, 2001a and 2001b; Mitchell, 2003; Andriole, 2006). This is due to the fact that jobs in the IT sector are most significantly challenged by the broad deployment of IT systems. Many computing jobs have been moved offshore where the labor costs of programmers and engineers are much cheaper. The rapid evolution of computer technologies is forcing IT workers who deal with computers to continuously learn new skills. IT workers have been supplied to the job market from various sources other than the traditional computing degree programs (Freeman and Aspray, 1999). It is generally agreed that the traditional computing disciplines in colleges, Computer Science (CS), Computer Engineering (CE), and Management Information Systems (MIS), are career-oriented majors and target the narrowly defined IT job markets. The changes occurring in the IT sector are placing pressure on these graduates to equip themselves with more versatile skills to secure their employment (e.g., Greiner, 2006; Lee and Lee, 2006; Moore and Love, 2005; Denning, 2001a).

Employment prospects of graduates have been a central issue among educators in another type of IT programs that were built on a broader collaboration between the traditional computing and non-computing disciplines. For example, a study conducted by Kazmer and Thakkar (2004) dealt with such an IT program, but their primary attention was also given to employment issues for IT jobs. Although they brought more broadly construed IT occupations, such as archivists, curators, museum technicians, librarians, and information scientists into discussion, their argument of adapting students' technological skills to the rapidly changing requirements of those jobs was not very different from the employment concerns which were the focus of the former type of IT programs.

The needs of college students regarding computing education are not limited to job prospects in the IT industry. Facer, Sutherland, Furlong, and Furlong (2001) argue that young children value computer expertise and are willing to learn computers when it is

valuable in achieving their practical objectives such as obtaining strategies to win their favorite games and in constructing identities in their peer groups. They argue that if those learners' motivation to learn IT is to complete tasks that are important to themselves, educators' attempts to help students achieve a broad theoretical understanding of the wider potential of computers would be only time consuming. Although their target group was young children who are different from college students, their study has significant implications in this study, in that educators should understand what values college students desire from a formal IT education opportunity.

Even if we assume that employment prospects are the central issue to students as previous studies did, the topics in the IT programs are not only applicable to students who pursue IT jobs. Those topics are also relevant to students who plan to work outside of the IT sector, as competencies in IT are required for almost any occupations that college graduates would pursue. For example, the core workplace competencies identified in the Secretary's Commission on Achieving Necessary Skills (SCANS) report (1991), resource managing skills, interpersonal skills, information skills, system using skills, and technology skills, all pertain to an understanding of information technologies and abilities to use them. Therefore, if IT competency is closely related to the workforce development issue, it is necessary to re-examine it in relation to the workplace requirements of diverse occupations beyond the IT sector.

Second, IT competency is not only about specific technical skills. The National Research Council (1999) introduces a new term, "IT fluency," to indicate the broad and fluid ability required for a person to be competent in using IT. IT fluency is the ability to understand IT broadly enough to be able to apply it productively at work and in everyday life (National Research Council, 1999). It argues that IT fluency involves not only "skills," but also more cognitive aspects such as "concepts" and "capabilities." The three components that constitute IT fluency are interrelated, but each component represents a meaningfully different aspect of IT fluency.

It seems that previously performed studies have focused mainly on the computer skills, or have broadly used the term "skills" to refer to IT competencies, without differentiating the skills from the other aspects of IT fluency. For example, the focus of Facer et al.'s

study (2001) is weighted more to children's actual use of computers, rather than to their conceptual understanding of IT or capability to do something important. Twidale (2005) also focuses on computer skills when he observes the informal help-giving interaction among people when they learn to use new computer applications. Neither of these studies has extended the research focus to people's conceptual understanding of computers, which is indicated by the "concepts" and "capabilities" components of the IT fluency.

The focus on skills is also prevalent in the literature on workforce development. North and Worth (2004) analyzed job ads for the period of 1992-2002 and found that computer skills are something that employers have consistently required from employees throughout these 10 years. However, computer skills specified in job ads are only superficial, as they tend to list no more than skills in dealing with some office software applications. In contrast, IT competencies are embedded in most skills required for the increasingly computerized workplaces. How are these requirements beyond skills for specific jobs being perceived by the future workforce? Previous studies overlooked that college students may want to acquire something beyond simple computer skills through IT programs in colleges. If the concepts and capabilities aspects of IT fluency are also considered, the role of higher education in providing IT education may become clearer.

Third, previous studies mainly dealt with educators' and program developers' concerns. There are many other stakeholders in undergraduate IT programs, such as policy makers, employers, parents, and students, in addition to educators and program developers. However, many previous studies have not incorporated other stakeholders' perspectives very much in their research. The main discussion issues have been the problems that educators had experienced in the process of developing a new program. The discussion topics rarely went beyond administrative issues in establishing a new program (e.g., Berghel and Sallach, 2004), placement issues of their graduates for IT jobs (e.g., Denning, 2001a), or curriculum development issues (e.g., Said et al., 2004; Landry et al., 2003). In these studies, other stakeholders' perspectives have rarely appeared. To address the scope and objectives of the IT programs properly, examining multiple perspectives on IT education is necessary.

College students are one of the most important stakeholder groups of college-level IT education. Although there are not many studies that have directly investigated students' perceptions, a few studies on computer learners indirectly indicate that students' perspectives may provide a unique piece of information to understand the need for this new type of computing education. Facer et al.'s (2001) observation that young children learn computers to achieve what their peer groups value raises an interesting point to investigate for various groups of computer users. Few studies have examined what students in higher education consider important in learning about information technologies. College students' motivations to learn computers are not like those of the young children aged 9 to 14 that they have investigated. Developmental psychologists suggest that college students have different values from those of young children. Especially, college students are situated in a transitioning period from education to "real world." Therefore, college years are the time when students make career related decisions. Smolak (1993) suggests that occupation-related values are a significant part of the process of their identity formation in colleges. His argument implies that the reason that college students would seek formal IT education may be related to developing their career plans.

Reffell and Whitworth (2002) provide an explanation that can serve as a common frame to address different populations' motivations to learn about IT. They argue that if de-contextualized IT education is pushed onto learners without fully considering their various reasons for using the tool, it will not be fully assimilated, or may even be rejected. The important goals that the learners intend to accomplish in their lives should be understood. For young children, such goals may include peer recognition, as Facer et al. (2001) have identified. For college students, such goals may also include obtaining marketability for jobs, which corresponds to educators' traditional concerns.

The Secretary's Commission on Achieving Necessary Skills (SCANS) report published by the Department of Labor in 1991 suggests that students' perspectives about what they need to learn for their lives beyond education may be different from what educators conceive. The report points out that there has been a long-standing miscommunication between educators and employers in nurturing students' competencies needed for their lives at work. According to the report, educators and employers each have been talking

about their own sets of core competencies. The report points out that these two sets of core competencies are actually the same, which are manifested in different ways. Since educators and employers have not noticed that they are actually emphasizing the same thing, there has been miscommunication between these two groups. This miscommunication has caused students to consider that what they are doing in school today bears little resemblance to what they will be expected to do in the workplace tomorrow. This argument of the SCANS report has implications for IT education, as IT is a topic that is often considered distant from the typical topics of education. Information technologies change very rapidly, their pervasive impacts reach a much wider range of social phenomena, and they are being more aggressively deployed in businesses than in schools. Therefore educators have hesitated to embrace IT as a subject to teach in formal educational curricula. Consequently, students consider that IT competency is required more from workplaces, not so much from schools. This gap in educators' and students' perceptions implies that students may have different thoughts about college-level IT programs that are worth investigating.

The limitations of the previous studies examined so far include a narrow focus on employment issues for IT jobs, a sole focus on computer skills, and lack of students' perspectives. These gaps suggest that an in-depth exploration of student perspectives on the emerging IT programs is necessary.

1.3. Purpose of the Study

The purpose of this study is to explore students' perceptions and expectations for formal IT education to advance the understanding of college-level IT education programs. Students' perspectives about the new type of IT education have not received much attention and rarely appear in the literature on IT programs. While many studies of IT programs appear in scholarly journals and computing magazines, relatively few studies have incorporated students' perspectives into their discussions. College students are the primary customer of the IT programs among the diverse stakeholders, but what students think about these programs remains as a missing piece.

Students' input is expected to provide an important piece of information in understanding IT programs for several reasons. First of all, students are the direct customers of these IT programs. A process of developing an effective consumer-oriented product or service always requires iterations of improving some of their features and receiving the customers' feedback on that improvement. To develop a sound education program that properly addresses students' needs, incorporating students' input in the discussions is a necessary step. Reflecting students' performances and feedback information is a commonly used strategy in developing a new curriculum or a new education program (e.g., Lake, 2003).

Second, the needs of students who are not pursuing traditional computing jobs regarding computing education have not been explored very much. Nearly everyone today needs to use computers and many people who are not in the traditional computing disciplines feel a need to study computing in some form. This increased need for computing education is one major point that the ACM/IEEE Computer Society has raised in their Computing Curricula 2004 report (Joint Task Force for Computing Curricula, 2004) in the discussions of the core curricula requirements for IT education programs. Not all of the people needing IT education seek IT jobs, nor are the aims of IT education limited to developing an IT workforce in the traditional sense. However, IT education is frequently being discussed in relation to IT workforce development without much strong basis concerning students' diverse needs.

Third, students may perceive the diverse forces that make college level IT education necessary differently than educators do. Information technologies are rapidly changing and have pervasive implications in the domains outside of education. Educators traditionally have hesitated to embrace something that changes at such a high speed as their subjects for teaching. Frequently, the concerns about teaching such subjects bring in a more fundamental question about the role of higher education, especially a debate of "education vs. training." (Hoyt and Wickwire, 2001) As students are less bound to such normative debates about what higher education's role should be, their perspectives should reveal some unknown interesting needs and expectations for the IT programs.

Fourth, literature points out that IT education that does not consider learners' meanings will not be easily assimilated by them. Education researchers (e.g., Facer et al., 2001; Reffell and Whitworth, 2002) and the digital divide researchers (e.g., Selwyn, 2003; Selwyn, 2004; Hargittai and Hinnant, 2005) alike have suggested that understanding immediate reasons and the practical values that learners attach to IT usage may be critical in understanding people's acquisition of IT competency. Computers are often a means to do something else, rather than being are a goal and an end in themselves. Therefore, understanding the goals that students try to attain with IT education is important information to understand the role of IT programs.

Fifth, interests in end user computing are generally increasing, as IT has become general work/entertainment tools for ordinary users as opposed to specific technologies for a small number of technical experts. This expansion of end user groups is a driving force that has significantly contributed to the growth of IT programs. College students are one of the most active end user groups. Therefore, what they expect from college-level IT education will provide important pieces of information in establishing the new type of computing programs, which are more geared toward end user considerations than the traditional computing programs.

From the above reasons, this dissertation research proposes to shift attention from educators' and program developers' perspectives which were dominant in the previous studies to college students' perspectives. By investigating students' perceptions and expectations, this study aims to contribute to a better understanding of the IT programs and eventually help educators get clearer ideas about what these programs should accomplish, and how these programs should be administered.

1.4. Research Questions

From the concerns raised in the above sections, the following research question has been formulated to guide this study:

> What are college students' perceptions and expectations for an IT education program?

Four related sub-questions were also developed to help answer this research question. One characteristic of college students that draws attention in exploring their values and expectations is their frequently reported IT savviness. In many discussions on the digital divide, it is already a generally accepted notion that the generational gap in IT usage level is substantial (National Telecommunications and Information Administration, 1999; Hargittai, 2003; Hargittai and Hinnant, 2005). Young people acquire IT skills more easily than older people, and use the technologies more intensively. This gap in IT savviness between the younger generation and the older generations has also been considered as a significant factor in various workforce training and development issues (e.g., Business Week, 9/18/2006). Do college students feel as competent in dealing with IT as they are generally believed to be? If they are really savvy at using IT, why would they pursue formal education in IT? What variables govern the relationship between their IT competency perception and their interest in IT education?

Besides, existing studies often report that young people obtain IT competency in everyday settings rather than through formal education or training (e.g., Twidale, 2005; Spitler, 2005). Young people often turn to each other for help with technology (Hawkins and Oblinger, 2006). If a large part of their learning occurs in informal learning situations, what kind of knowledge about IT in addition to their existing competencies do they desire from formal IT education?

As people's interests and stakes following IT deployment vary greatly depending on their own backgrounds and situations, it is expected that college students across different majors have different perceptions regarding what they want from IT education. How are students' needs for formal IT education related to their current majors?

Challenges that traditional IT-related majors confront are being frequently addressed in scholarly journals, magazines, and newspapers. Jobs in the IT sector are precarious. The IT workforce is expected to have higher level competencies and more versatile skills than ever. However, it is not clear if these concerns are being sufficiently addressed within their majors. Students in the traditional IT-related majors are generally IT-savvy, as their academic performance is more pertinent to their understanding and skillful use of technologies than that of non-IT majors. If this group of students feels that they need IT

education that is different from their current majors, what do they expect to obtain from an IT program?

Challenges that non IT-related majors confront regarding IT are less well understood. When and why do non IT-related majors want to learn about IT? Although many computing jobs are being filled with people who have not received formal computing education(e.g., Freeman and Aspray, 1999; Simonson, 2002), not all non IT-related majors want to receive computing education specifically because they want to go into the professional computing field. Non-IT related majors may want some sort of computing education not necessarily because they want to pursue a computing profession, but also for a variety of other reasons. The concerns of this student population have not been addressed enough either in traditional computing disciplines or in other disciplines. What do students in various majors outside of traditional computing education programs expect from an IT program?

Students' current majors are closely correlated with the career fields that they would pursue, but college majors do not necessarily indicate the types of career fields they would pursue after graduation. For example, an English major may want to become a teacher, a journalist, or a manager in a business organization, but another English major who is very competent in handling computers may want to find a web developer position in his or her subject field. A CS major may want to focus on programming, but another CS major may want to obtain more business knowledge and move into a management position. Therefore jobs that they seek may make a difference in their expectations for IT education. This observation leads to another question: How do students' needs vary depending on the types of career fields that they are envisioning, rather than their current majors?

The questions raised above were summarized into the following four sub-questions:

(1) Do college students perceive themselves as being technically competent?

(2) Do college students perceive a need for formal education in IT?

(3) How do college students from different majors feel about the value of IT education?

(4) How do college students feel about the value of IT education for the careers they plan to pursue after graduation?

1.5. Method Overview

There is not a lot of existing literature that addresses the questions raised in this study, as the development of the college-level IT programs is a new phenomenon and students' perceptions of these programs have rarely been studied. Those studies that exist are dispersed across a wide range of disciplinary areas, including Education, Computer Science, Library and Information Science, Sociology, and Human Resources, etc. There is no comprehensive theory that integrates pieces from these different fields. This lack of previous research frameworks requires this study to conduct some groundwork in order to identify the major issues.

This groundwork was established in this study, using data obtained through qualitative in-depth interviewing with college students. To discover the perceptions and expectations of college students regarding a college-level IT education program, this investigation followed the grounded theory approach suggested by Glaser and Strauss (1967). The grounded theory approach is appropriate for this inquiry, because of its bottom-up approach of identifying major themes from the data. It intends to construct a middle-level theory directly out of the data obtained from the informants rather than trying to confirm or challenge a pre-existing conceptual framework.

1.6. Benefits of the Study

This study is developed to fill the gap in the previous studies by highlighting students' perspectives on college-level IT education. In spite of the increasing popularity of new IT programs in colleges, no general agreement exists about their nature and scope. Inability to establish an identity of the IT programs may be due to the lack of research findings that can serve as a common ground on which educators can communicate and exchange ideas. As pointed out in the previous sections, students' perspectives remain a missing piece in the existing discussions. If students' perspectives are added to the existing body

of knowledge, it would be a valuable piece of information that would help answer questions such as why these programs are needed and what these programs are expected to accomplish. In addition, the findings of the study will eventually help educators answer some long-standing questions about the role and scope of IT programs in college.

Although this study is not designed to provide quantitative data that would represent perceptions of larger student populations, it does have a practical value in program development. This study is designed to discover the needs and expectations of students by listening to their thoughts as expressed in the in-depth interviews. It also aims at discovering the significant variables that would influence their perceptions and expectations. Therefore, this study will inform educators and administrators involved in developing an IT program of the blind spots that they may have. In building a new education program that can appeal to and be useful to all the stakeholders, understanding how students view the significance of IT education is valuable. On the basis of the issues and variables identified from this qualitative study, a survey instrument could later be developed and administered to a larger population of students.

1.7. Definition of Terms

The term "IT programs" is used to indicate the group of the newly emerging computing programs that have been described so far. As the scope of this new type of computing education is not well-agreed upon, there is no standard term to indicate those emerging education programs. For example, in a survey of graduate information programs in the U.S. conducted by Becker (2008), it was reported that about 60% of those programs have a name as diverse as Information Systems, Informatics, Information Technology, or Information Science. The remaining 40% of the programs are distributed across diverse fields, such as Business, Biological and Health Sciences, Library Science, Public Administration, Communications, and Education, and have a name that represents their departmental affiliations. The specific IT program that is the research site of this study also has changed its name a couple of times over the past years. Therefore, a generic term to indicate this group of programs is needed. The term "IT programs" is used in this

dissertation to point to the group of newly emerging computing education programs that is the focus of this study.

The term "traditional computing education programs" is used in this dissertation to indicate the existing computer-related disciplines. This group of programs includes Computer Science, Computer Engineering, Management Information Systems, etc. The term is used to differentiate these traditional computing education programs from the new IT programs.

Sometimes different technological majors are called "IT-related majors" in aggregation, to contrast these majors to the Liberal Arts and Social Science majors. Although not all technological majors directly deal with IT, technological majors in general are closer to IT than the Liberal Arts and Social Science majors, in that these fields require intensive training in math and sciences as their fundamental principles, in common with the traditional computing education programs.

2. LITERATURE REVIEW

2.1. Laying the Setting: The Knowledge Economy

2.1.1 The Knowledge Economy and Information Technology (IT)

We live in a knowledge economy where knowledge and information have become the primary economic resource. Since the term knowledge economy started to become popularized in the1960s by scholars like Peter Drucker, it has inspired many researchers to describe a new economy in which intangible intellectual resources generate much greater economic value than tangible physical assets. Many historians and economists observe that the economy has continuously evolved throughout history from a traditional material-based economy to a knowledge-based knowledge based economy. They generally agree that the growth of the knowledge economy was accelerated in the 1990s, with the explosion of computer technologies and the Internet (e.g., Wolff, 2005). However, it is important to note that knowledge and information do not create value in themselves. Creating value from knowledge and information requires humans' active mediation, as it is humans who create, retain, process, and integrate various types of knowledge.

As gathering and processing information and applying it to create value has become the primary economic activity, "knowledge workers," workers who mainly deal with knowledge and information instead of raw materials, are the main actors that generate value. The defining characteristics of knowledge workers vary, as scholars from different disciplinary traditions have used the term for different purposes. Sociologists used the term knowledge workers to indicate a class of workers who replaced factory workers in the transition from the industrial economy to the knowledge economy (Cortada, 1998). Business people used the term to indicate a group of workers engaged in research and development (R&D) tasks, as opposed to workers engaged in simple routine tasks (e.g., Van Buren and Werner, 1996). In spite of the different traditions, the literature from different disciplines commonly points out that the prerequisite to become a knowledge worker is higher education, because nurturing the high-level cognitive abilities to perform the intellectual tasks has been traditionally considered as a central role of higher

education. Pyoria (2005) argues that the growing demand for informational labor that is capable of handling, synthesizing, and creating new knowledge is putting pressure on higher education to meet the requirement.

Today, people's ability to work with knowledge and information has become inseparable from their understanding of information technologies (IT), as a huge amount of information now is generated and exchanged on networked computers. Historians observe that new information technologies have continuously appeared throughout history, and any new information technology had prompted a new type of knowledge work of that time (e.g., Cortada, 1998). However, it is the modern development of cheap networked computing that has truly realized the knowledge economy in the current sense, as virtually all the economic activities today are dependent on modern information technologies (Prusak, 1998). Therefore, understanding of computing technologies has become another prerequisite to anyone who is engaged in knowledge work along with higher education.

Considering that the major activity for knowledge work is dealing with intangible knowledge resources and that this intellectual activity is inseparable from use of IT, it is not coincidental that higher education and use of IT appear together as the two necessary conditions to define a knowledge worker. This observation suggests that college students' needs for IT education may be closely related to the new requirements for human workers in the knowledge economy.

2.1.2 IT and the Changing Requirements for Human Capabilities: "A New Division of Labor"

Although the impact of the recent IT development is all-encompassing across many spheres of humans' life, one area where IT is most heavily deployed and most dramatically challenging humans' roles is workplaces. Many previous studies point out that the expanding deployment of computer systems is the major factor that has brought dramatic changes in the way people work. In his popular book "The World is Flat," Friedman (2004) vividly illustrates how work is being performed collaboratively at a global level mainly due to the wide deployment of information technologies. Computers have altered not only the speed at which work is conducted but also have redefined the

way thousands of different kinds of work are carried out. People exchange the intangible intellectual products seamlessly at a greater scale than ever. These changes have impacted not only a few selected types of work that directly deal with computer technologies, but also have affected a broader range of workers who deal with knowledge and information (U.S. Department of Labor Secretary's Commission on Achieving Necessary Skills, 1991).

Several studies describe how implementation of IT has challenged humans' capabilities in performing various activities. Zuboff (1988) discusses two ways that IT has affected people's work. One is what she calls "automating," which indicates the automation of existing work processes. Automation has taken over simple and repetitive tasks that used to be performed by humans, hence has replaced a large part of human workers' physical labor.

Furthermore, Zuboff (1988) contrasts "automating" with another capability of IT systems, what she calls "informating." Computers are not only replacing people's routine tasks, but also continuously generating information about work processes. She originally used the term to describe the processes in which managers use the information streams with an intention to exert tighter managerial control over low-level routine workers. However, this informating capacity challenges knowledge workers in another way as well. They need to process a large amount of extra information and create value from it. Therefore, for knowledge workers, this informating capacity bears much greater significance than automating. On the one hand, IT has enabled those workers to extend the domains of their intellectual activities. It allows them to utilize a large amount of information from a variety of sources in carrying out their work, which had not been possible before. On the other hand, it means that now the knowledge workers must acquire a higher level of intellectual capabilities of working with a large amount of information. In turn, it also implies that those workers need to operate IT more adeptly, as the major platform upon which the intangible knowledge assets are generated and exchanged is networked computers.

Education and labor researchers Levy and Murnane (2004) discuss a "new division of labor," a boundary drawn between human capabilities and information technologies.

Their basic premise is that there are some tasks that humans perform better than computers and there are other tasks that computers perform better than humans. One's relative advantage over the other draws a new line between a zone for human labor and that for technologies. The tasks that humans perform better include expert thinking and complex communication. The tasks that computers perform better include routine cognitive tasks that can easily be described by logical roles. They argue that the boundary is continuously being re-drawn, as the computing capacity is evolving rapidly. Pyoria (2005) argues that the most important skill that a knowledge worker should possess is the ability to build upon his or her previous state of expertise, because the life cycle of advanced knowledge and new technologies is getting shorter and shorter.

Appelbaum and Batt (1994) illuminate the high performance pressure that workers face in the current economy from a labor economists' perspective. They point out that the shift from mass production to flexible specialization which followed the increased international competition since the 1980s has forced the American work systems to require higher level performance from the workforces. This "high performance work system" tries to obtain higher labor productivity by broadening workers' repertoires of skills and behavior and enlarging worker-level flexibility and discretion. These enlarged capability requirements call for stronger general skills and enhanced self-learning abilities from the workers. The notion of the high performance work system has provided a significant ground for American education to make an effort to nurture more capable future workforces (e.g., U.S. Department of Labor, 1991).

To update their skills so that they can carry out tasks with flexibility and discretion, workers need to receive training accordingly. Cappelli (1999) observes that there is a trend in the labor market that responsibilities for updating workforce capabilities are being pushed more onto workers themselves. Traditional wisdom was that employers nurture the workforce capabilities that they need by providing internal training to their employees. Now, employers are increasingly obtaining the manpower from the external job market instead. Instead of nurturing the skills that they need, employers just purchase the competencies they need at a market price. The weak employment relationship signals that workers should develop the fundamental abilities to learn new things continuously by themselves. The expectations for higher human competencies, together with the increased

responsibilities for training pushed onto workers themselves, necessarily result in pressure for higher education to change accordingly.

2.1.3 The Role of Higher Education

The growing importance of fundamental human learning capabilities in the knowledge economy has caused many researchers to reconsider the relation of education to work. Labor economics studies have distinguished two types of workforce skills, general skills and specific skills. General skills are skills that are applicable in different settings and a common requisite for most jobs in different enterprises. Specific skills are skills that are unique to a single job classification in a single enterprise. Investment for general skills is typically incurred by workers, whereas investments in employer-specific training are incurred by the employers (Becker, 1964). Labor economists Doeringer and Piore (1971) point out that the higher the requirement for general skills, the more education receives attention as a major actor that is responsible for strengthening workforce's general skills.

Today the ability to work with IT no longer denotes specific skills that only a few people need in order to perform some specific tasks. The ability to work with IT is becoming a general skill that everyone is expected to have, as IT has become the general infrastructure upon which most economic processes are built. Creating information from data and reconfiguring it to yield knowledge products are the primary activities of many workers in today's workplaces (May, 2005). Therefore, people are expected to acquire sufficient understanding of IT from education before transitioning to the world of work.

In spite of the continued growth of higher education, recent research from the U.S. Department of Labor Bureau of Labor Statistics (2003) points out that employers constantly perceive a chronic skill shortage, as the accelerated need for more highly educated workers in the current economy is not being met. Elias and Purcell (2004) observe that the expansion of higher education in the 1990s resulted in an increased number of college graduates. However, they argue that the large number of college graduates does not necessarily mean that there are more qualified workers than before. As many of them lack an appropriate level of workplace skills in spite of their high level of education, an increasing portion of those graduates is unable to access an employment

opportunity. May (2005) also observes that many workers these days are not qualified enough to carry on knowledge work in spite of their high education level.

The Secretary's Commission on Achieving Necessary Skills (SCANS) report submitted by the U.S. Department of Labor in 1991 is a seminal work that calls for educators' effort to prepare students for workplaces where increasingly high level skills are desired. The SCANS know-how is composed of five competencies: planning resources, using information, acquiring interpersonal skills, understanding systems, and applying technology (SCANS, 1991). It is apparent that understanding of technologies and abilities of utilizing information are identified as core workforce competencies. This can provide a strong basis for an argument that the IT education programs emerging in colleges have implications in nurturing capable workers in the knowledge economy. The SCANS report points out that the fundamental changes computers have brought into workplaces require fundamentally different human capabilities, which in turn make schools change the way that they prepare students for future life. It is needless to say that the primary role of educational systems is more than simply preparing people to make a living, but preparing students for future life is another important function of an educational system. In this sense, the report strongly calls for a closer collaboration of educational systems in developing the workforce competencies necessary to nurture more productive workers in the new economy.

Recognizing a need to affirm the viability of the competencies identified in the SCANS report, North and Worth (2004) conducted a longitudinal study that examined the viability of the competencies for the following 10 years. By analyzing job requirements specified in job advertisements during the 1992-2002 period, they found that the basic workplace competencies identified by SCANS had been continuously sought by employers during that period. Therefore, they concluded that the SCANS competencies have had the same viability during this period and will be so for the years to come.

2.1.4 Summary

It seems that a significant context to consider in examining the growth of IT education programs in colleges is the rise of the knowledge economy. In the knowledge economy, information and knowledge have become the primary economic resource to create value.

Also, IT has become the primary means of generating, delivering, and exchanging intangible intellectual resources. Consequently people's ability to work with knowledge and information has become more closely connected to their understanding of IT. In addition, the changing workforce requirements for versatility and flexibility require higher cognitive abilities from the workforce. These trends signal that higher education is receiving pressure from workplaces to nurture highly competent future workforce. It seems that the emergence of IT education programs in colleges is one manifestation of the new requirements for education. Supporting the economy by preparing a competent labor force has always been an important function of higher education. Therefore, the new stakes that have arisen in the knowledge economy are laying the ground upon which IT education programs in colleges are built.

2.2. Emerging IT Education Programs in the US Colleges

2.2.1 Introduction of IT Programs in Colleges

Recently, many U.S. colleges began to offer new IT education programs in addition to the traditional computer-related education programs such as Computer Science (CS), Computer Engineering (CE), and Management Information Systems (MIS). The titles of these IT programs vary across a substantial range, such as Information Science, Information Studies, Information Technologies, Information Technology Studies, Informatics, Internet Studies, etc. The issues involved in establishing an IT program are even more diverse than the titles of the IT programs. As a result, some researchers have come to a conclusion that it may not be possible to speak of a generic IT undergraduate degree (Reichgelt et al., 2004). In spite of the diversity, the IT programs may be grouped according to the affiliation of the major program initiators and their motivations.

2.2.2 IT Education Programs Initiated by the Traditional Computing Disciplines

Some of the new IT programs were initiated by collaboration of educators from the traditional computing fields, which include computer engineering, computer science, information systems, and software engineering (ACM/IEEE Computer Society Joint Task Force for Computing Curricula, 2004).

Emergence of the IT programs out of the traditional computing fields is largely due to the challenges that people in IT occupations face in their professions in changing work settings. Denning's (2001a) concern about computing graduates' weakening power in workplaces exemplifies the challenges that IT people are facing. He argues that the computing discipline, which gave birth to the IT profession, has lost the initiative in the profession due to various other forces, and the IT workforce is no longer controlled by computer science. He argues that IT professionals find themselves challenged by a multitude of users with mundane, practical concerns about using and relying on computers.

To cope with challenges, the IT workforce most urgently needs versatility, which includes much more than technical know-how. Denning (2001a) calls for a new IT workforce that can communicate with the multiple forces and embrace commercial applications, interact with people from other fields, and deal with the concerns of their customers. In the same line, Greiner (2006) recommends that those who hope to make a career in the computing fields must learn how to become multi-disciplinary, as today's IT professionals juggle many tasks and roles. Mitchell (2003) argues that the current CS and engineering programs are producing workers who lack soft skills and an understanding of professional behaviors that would support their successful career development. He argues that graduates from technical fields tend to lack an understanding of the nature of "real world" problems and the context in which the problems are solved, and that employers want more from the graduates that the universities have been producing. For example, employers want to see graduates who appreciate the importance of data in addition to those who are oriented towards code, and who think in terms of customer solutions rather than hardware or software solutions (Mitchell, 2003).

Medlin, Dave, and Vannoy (2001) argue that the dynamic environment of technology and changing business needs require today's IT professional to possess a wide range of technical and non-technical abilities together. Organizations expect their IT employees to combine business skills, analytical thinking and the ability to exhibit expertise in an array of technology areas. Their survey indicates that the required non-technical skills including communication skills, analytical, and managerial skills are as important as technical ability for IT workers.

In the meanwhile, the speed at which technologies change is rapid, and this change creates continuously increased skill demands, which result in overburdened IT professionals (Moore and Love, 2005). A negative consequence of the overburdening is that it makes IT professionals "bad citizens" in their organizations, unable to commit themselves sufficiently to accomplish more than their minimum responsibilities. Hira (2004) expands IT workforce educators' attention to a global level. He observes that many employers are moving white-collar jobs overseas. This is especially true for computing jobs, and technology workers have been disproportionally affected by persistent joblessness. He argues that higher education should create new programs that are more responsive to emerging demands in the technology fields.

Another major field of traditional computing is management information systems (MIS) in business schools. It seems that MIS graduates' experiences at work are not very different from the graduates from those of their peers in computing fields. Prager (1998) argues that the adoption of strategic technologies, and a flattening organizational structure that does not provide employment guarantees are giving pressure to information system professionals to acquire new skill sets suited to the changing business environments. Fang and Lee (2005) describe MIS students' challenges regarding employment in the changing labor market. They argue that due to sharp IT budget cuts, the slowing economy, and outsourcing, job opportunities for MIS graduates are becoming scarcer than even before. To adapt to these changes, they argue, MIS students will need to adopt aggressive approaches to securing employment, such as acquiring more internship experience, adding additional majors, and taking more technical courses. The number of business students who choose MIS is decreasing. Also, MIS students who choose to earn double majors are increasing. These trends are based on the recognition that expert knowledge in computing is not enough to survive for them at workplaces.

To summarize, one major reason that new IT programs emerge from the traditional computing disciplines is that the new knowledge and capacities are required for computing professionals, beyond those taught in traditional computing programs.

2.2.3 IT Programs Initiated from Broader Collaboration of Traditional Computing Fields and Non-Computing Fields

As most computers are connected on the Internet, computers have become more available to people who are not computing professionals and they are now a primary tool to mediate almost all types of intellectual activities. Handling information requires higher-level thinking skills, which makes it a more suitable topic for higher education to deal with. While computer education in K-12 does more harm than good to students' learning by depriving children of opportunities to obtain direct perceptual experiences, grown-up learners are relatively safe from such risks. The potential of the Internet to support constructivist learning looks especially ideal for adult learners, because it allows learners to seek out and use learning resources independently, to control the pace and the direction of learning, and to consult other people easily (Imel, 2003).

A more fundamental reason for educators to pay attention to students' IT competency is that technologies are increasingly embedded in every aspect of societies' functions. Educators believe that if one does not have an opportunity to obtain IT competency, that person will be significantly less able to serve as a responsible citizen in a computer-centered society. For example, the Web has made information easily available to anyone. However, if a user does not sufficiently understand that anybody could post information online and the anonymity in the virtual space may allow individuals to act differently than they would in a physical space, then users may make the mistake of trusting random information from the Internet as much as information from more authoritative sources. In this sense, IT competency is taken as a generic skill along with math and reading skills.

However, the broad interest in enhancing students' IT competency from educators outside of the traditional computing fields has not necessarily resulted in building new IT education programs. Many such educators have tried to include IT competency in the existing curricula. Other educators, who are not from the traditional computing fields, have tried to build new programs based on a broader collaboration between educators in the traditional computing fields and those from non-computing fields. Many of these programs are organized by library and information science (LIS) and liberal arts disciplines in collaboration with the traditional computing fields. Some of the educators

who are active in this line are from LIS (e.g., Sherron and Landry, 1999; Koteles and Haythornthwaite, 2002; Kazmer and Thakkar, 2004)

The studies from this position tend to simply borrow discourses from the traditional computing disciplines to justify their special needs and their reasons for building new programs. They tend to lack strong theoretical or empirical ground in their discussions. For example, they tend to mention prospects for IT jobs and internship opportunities as major success factors of the IT programs without examining their students' needs and expectations. However, the students in their programs are different from the students in traditional computing fields although they share some commonalities. It is partly because of the breadth and novelty of the issue, or lack of collaboration and consensus among disciplines, or simply due to the lack of a well-defined body of knowledge that would serve as a framework to address the issues.

To summarize, IT education programs initiated by non-computing fields include a much broader range of issues than traditional computing. Such programs also mention the issue of employment in the changing workplaces as one of their major concerns. However, these remarks are being made without clarifying what kind of workforce needs IT competency or what kind of IT competency is required for the positions outside of the traditional IT sector. Nor have they tried to answer these issues by investigating the perceptions and expectations that students have regarding the IT programs.

2.2.4 Common Characteristics of IT Programs

Nevertheless, some common characteristics of new IT programs may be observed. These common aspects include strong emphasis on information, interdisciplinary endeavor, a broader target group, and concerns for graduates' employment prospects.

Focus on Information and the Contexts of IT Application

A common component that appears in the various titles of IT programs is "information." Increasingly information implies information technologies, as information is inseparable from information technologies in the era of digital communication. However, this terminology also indicates that the focus of those programs is more on information, the product generated from IT, than on the technologies themselves. Understanding in

technologies has become generally required for any type of work, as opposed to specific occupations, deployment of IT in any work setting now requires considering intertwined technological and contextual issues. These contextual issues have rarely been addressed in the purely technological discussions.

Interdisciplinary Endeavor

Because of the focus on the diverse contexts in which IT applications are embedded rather than technologies themselves, efforts to organize IT education in colleges are usually made as a collaborative endeavor across dispersed disciplines (e.g., Berghel and Sallach, 2004). Mitchell (2003) argues that IT programs reflect the interdisciplinary nature of modern computing applications and provide a venue for addressing any kind of computer-based problem. Denning (2001b) tries to raise awareness that IT educators are now facing the challenge of designing a program of study for IT that is not constrained by idiosyncrasies of a particular specialty, especially those of computer science. He continues that the field of IT education includes segments from various disciplines: Computer Science, Information Science, Public Policy, and Business. Faculty composition of those IT programs also indicates their interdisciplinary nature. There are no official statistics that summarize the faculty composition in IT programs, but it is easy to observe that the faculty members in IT programs are gathered from various disciplinary backgrounds. Landry et al. (2003) argue that the development of IT curricula in colleges is one of the most important educational innovations in recent years, and that such IT innovativeness comes from an attempt to move beyond the confines of traditional academic and disciplinary boundaries.

Berghel and Sallach (2004) observe a phenomenon that many IT programs are being organized at a university level, rather than at a departmental level. They found that although many IT programs differ on a wide range of subject areas, they are highly similar in their reporting structure, in that a majority of the programs reports directly to either the Provost or the Vice Chancellor. It may be an indication of the needs for coordinating diverse interests of educators from many disciplinary areas. It also may be an indication that the IT programs face diverse pressures from outside of education as

well as from inside. Diverse interests involved in these programs are contributing to the complexity in establishing a clear identity of the programs.

Broad Target Group

These programs usually are targeting a broader group of students than traditional computing programs, as the programs are typically targeting at a niche between technologies' fields and social sciences. As Mitchell (2003) points out, IT programs that are being offered as an academic major do not intend to replace the pre-existing computing disciplines. Rather, they intend to provide education related to computing to students outside of the narrowly defined traditional computing area. Having a broader target group is also obvious in a suggested IT curriculum that the Joint Task Force for Computing Curricula suggested in 2004. In the Joint Task Force's report, the area of IT is weighed heavily toward application and deployment of IT, rather than computing principles, programming, or system architecture. The different focus signals that the IT area is targeting at a different group of students, who would not enroll in the traditional computing majors. While some IT programs are built as a standalone academic major, other IT programs are being offered as a minor program in colleges. These programs are targeting an even broader group of students. These IT programs are concerned about enhancing students' capability in doing their important tasks with the support of IT. These programs commonly have concerns about boosting students' capabilities in performing important tasks in their domains of work, either for their current school work or for future work after graduation.

Concerns for Students' Employment Prospects

Many previous studies on these new IT programs are expressing at least some considerations for developing IT workforce (e.g., Sherron and Landry, 1999; Koteles and Haythornthwaite, 2002; Kazmer and Thakkar, 2004). Denning (2001b) and Landry et al. (2003) discuss the issues of IT education in close relation to jobs in the IT sector. Denning (2001b) argues that the significance of the movement to organize IT schools on campuses is a welcome development to form IT professions in the new economy. Landry et al. (2003) also view that the purpose of the development of IT curricula in colleges is to meet the breadth of knowledge needed by IT professionals. Sherron and Landry (1999)

argue for an IT program in their institution on the ground of the expanding information-related jobs. They argue that the number of jobs in the information sector has been rapidly growing since the advent of the information society, and that information-related jobs require individuals who possess the necessary knowledge and skills. They argue that universities need to fill in the positions by nurturing the competence. Koteles and Haythornthwaite (2002) observe that IT programs that are affiliated with the Association for Library and Information Science Education (ALISE) schools stress preparation for participating in the IT workforce, whereas non-ALISE affiliated programs tend to stress analysis and understanding of technologies' impacts. Kazmer and Thakkar (2004) report their observation of students in their undergraduate IT classes and they point to the surging demand for IT workforces as a rationale for offering IT education at a college level. Referring to the reports from the Bureau of Labor Statistics, they argue that computer-related occupations have been growing, and argue that professionals in such broadly construed IT-related occupations must learn to adapt their skills quickly to emerging technologies. To summarize, most of the studies suggest that qualified workers are in short supply and that the necessities of the IT programs have to do with changes occurring in workplace competency requirements. Focusing on students' economic advantages and employment prospects in developing IT programs makes sense, because IT has been more aggressively deployed in workplaces than in other fields and is continuously redefining human workers' roles. However, it is also observed that the previous studies tend to bring IT workforce issues into discussion without carefully examining their use of the term "IT workforce."

In summary, it seems that the IT programs do not nest neatly within existing departments, schools, or colleges. This is why the identity of such programs is still not clearly defined in spite of the growing popularity of the IT programs. Some professional organizations such as the IT deans' meeting at the Computing Research Association (CRA) and the Special Interest Group in IT education (SIGITE) at the Association for Computing Machinery (ACM) have been quite active in discussing the diverse issues regarding IT education. Although these professional organizations of IT educators have made considerable efforts to establish a recognizable identity by establishing common curricula for the family of computing disciplines, the new IT programs still remain ill-defined

(Subramaniam, 2005). As Berghel and Sallach (2004) suggest, it may not be possible to talk about the definitive identity of the programs that are still in a nascent stage. Instead, they argue, only a pattern survey of these burgeoning programs would be possible at this stage. So far, not many such studies have been done. One salient pattern, however, would track the program initiators' departmental affiliations.

2.2.5 Summary

It seems that IT programs in colleges are increasing and becoming popular. There are still many unresolved issues regarding their identity, program administration, and the curriculum, etc. Educators from different disciplinary areas have different concerns, but collaboration among them is being desired to build a good interdisciplinary program that can address diverse topics that span social problems and technological problems. College graduates' employment prospects are a topic that frequently appears across diverse discussions on IT education. However, it seems that many of those studies do not have a strong ground regarding either employment or IT workforce development. They tend to lack clarification on what the range of IT workforce is, how IT workforce requirements are changing, or what concerns students who do not pursue an IT sector job have regarding their IT competency. Also, the IT workforce development issues have not been explored with college students themselves. If the employment prospects continue to be a topic, the issue should be explored further.

2.3. Historical Issues in IT Education

2.3.1 Computer Literacy Education

Interest in the ability to use information technologies has been surging since the Internet became publicly available, but the interest in teaching students to use computers is not new to the Internet age. Long before the Internet became widely available, there have been intense discussions among educators on how they can guide students to obtain enough computer expertise. In the past, a job that involved computer uses often meant more advanced type of work that required special skills. Such jobs were often accompanied by high wage. That general idea is still being held by many human resource

researchers who do not have specialized knowledge in jobs in the computing fields (e.g., Cappelli, 1999; Osterman, 2006). Acquiring a job that involves computers once meant upward mobility on the social and economic ladder. The prospect for obtaining better future jobs led educators and parents to value computer literacy as an important educational objective that schools needed to pursue. Teaching computers in schools was justified based on a belief that the earlier students experience computers, the better they would adapt to the increasingly computerized workplaces (Cetron, 1983; Oppenheimer, 1997; Adya and Kaiser, 2005). Because earlier exposure to computers would help students feel more comfortable with complex technologies, educators wanted to provide all of their students with at least some opportunities to experience computers early in their lives.

Computer literacy education is different from other types of computer education in that it targets end users rather than computer programmers or engineers. Because being savvy at using computer applications is different from knowing how to program or how to install computer hardware (e.g., Collins Dictionary of Computing, 2000), the objectives of computer literacy education have been different from those of other kinds of computer education aiming at developing computer professionals (Reffell and Whitworth, 2002). The earlier history of computers shows that computers were developed primarily as business tools (Cortada, 2004). In that context, the term "end users" usually referred to employees in computer-centered workplaces, and acquiring computer literacy often meant acquiring basic technical skills needed to operate workplace computers.

Describing a cashier's job at a fast food restaurant as an example, Harvey (1983), a computer scientist and educator, demonstrated some serious limitations of computer literacy education. He pointed out that the cash register machine that the cashier interacts with in the example is not a simple calculator. Rather, it is a computer which is connected to all other value production capacities of the restaurant. When the cashier receives an order for a quarter-pound hamburger with cheese, he just needs to press a button labeled "quarter-pound hamburger with cheese." By pressing a button on the cash register machine, the cashier generates information that circulates throughout the whole order processing workflow. The order information affects all the other jobs at the restaurant. Nevertheless, the skill set required for the cashier is no more than pressing an appropriate

button for orders, which does not require the cashier to understand any communicative processes that his or her action would trigger. In this respect, Harvey argues that there is a fundamental limitation in computer literacy education that aims at assisting end users to prepare workplace skills.

Facer, Sutherland, Furlong and Furlong (2001) argue that there has been a fundamental gap between the reason that educators, policy makers, and parents place emphasis on computer education, and the reason that children themselves value computer expertise. They observe that policy makers and parents tend to view computer skills in terms of the children's adaptability to the future world of work. They point out that children may acquire computer skills for different reasons such as building an identity in their peer groups.

2.3.2 Related Literacy Concepts

Now computers have become a primary tool to mediate any type of intellectual activities. Since computers have become widely available even to students with no technical background, the focus of discussions has shifted from the technical ability of dealing with computers to the cognitive ability of dealing with information. In the shift, other related types of literacy are relevant in understanding the new requirements for IT competency.

Information Literacy

As computers and the Internet are widely used for every type of intellectual work, interest in information literacy is soaring in many sectors. As the word "literacy" indicates the ability to read and write, information literacy indicates the ability to find and use information to perform any task that requires useful information. The most widely cited definition of information literacy is the one that the American Library Association (ALA) summarized in 1989. ALA mentions "information literate people are those who have learned how to learn. They know how to learn because they know how knowledge is organized, how to find information, and how to use information in such a way that others can learn from them." (ALA, 1989) This is a useful definition, but the development of IT and its wide use requires an updated definition for information literacy.

The term "information literacy" has lately been receiving attention from outside of the LIS field. Scholars from other fields, such as sociology (e.g., Hargittai, 2003 and 2005), communication (Correia and Teixeira, 2003), and business strategy (e.g., Drucker, 1994) are greatly interested in the significance of people's abilities to deal with information. A report published by the European Commission (1996) on workforce development also argues that the deployment of information technologies in the workplace is causing serious skill gaps, which require people to acquire a new skill that can be called "informacy." That report also argues the importance of education and training, saying that they should be overhauled to match the IT evolution and bridge new skill gaps. They take the literal meaning of "information literacy" and use the term to indicate a general ability to deal with information.

Although this literal definition is a very useful concept, it is biased toward disciplinary academic activities and library education (e.g., Simmons, 2005). This sort of information literacy has its own value in supporting education and disciplinary activities, therefore it is not desirable to simply transplant the whole concept to refer to a competency that works in a different context. Still, as the primary value of IT is generating and manipulating information, information literacy is a very useful concept in the context of IT competency.

ICT (Information and communication technology) Literacy

As the realm of information has shifted into the digital world, the meaning of information literacy has been experiencing significant challenges. Education researchers Shapiro and Hughes (1996) suggested earlier that at least part of information literacy should be defined by IT components. Recently, a newer concept "ICT literacy" (Information and Communication Technology literacy) is gaining popularity. The Educational Testing Service (ETS), a major player in educational testing, defines ICT literacy as "using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society." (ETS, 2005) ETS has started to offer a standardized test that measures those knowledge and skills. It is interesting that the new "ICT literacy" emphasizes the information skills and communication ability over technological abilities of using computers.

A fundamental reason for educators to pay attention to ICT literacy is that technologies are increasingly embedded in every aspect of societies' functions. Educators believe that if one does not have an opportunity to obtain ICT literacy, one will be significantly less able to serve as a responsible citizen in a computer-centered society. For example, the Web has made information easily available to anyone. However, if a user does not sufficiently understand that anybody could post information online and the anonymity in the virtual space may allow individuals to act differently than they would in a physical space, then users may make the mistake of trusting random information from the Internet as much as information from more authoritative sources. In this sense, ICT literacy is taken as a generic skill along with math and reading skills.

Media Literacy

Another related literacy concept is media literacy, which indicates the ability to think critically about information coming out through popular media such as radio and television (Porter, 2001). Media literacy is relevant to an attempt to understand IT competency, as it also has focused on information. Aufderheide (1993) defines media literacy as the ability to access, analyze, evaluate, and information in a variety of forms of popular media. It is an expanded information and communication skill that is responsive to the changing nature of information in the society. Considine (1995) mentions that it includes the skills students need to be taught in schools, the competencies citizens must have as people consume information in their homes, and the abilities workers must have as we move toward the 21st century and the challenges of a global economy. It is easy to see that the focus of media literacy is people's ability to use information that comes out from the popular media.

One of the biggest objectives in media literacy education is raising people's awareness of capitalistic influence on information that reaches a broad range of people (Kmitta, 2000). As most of the world's media are owned by a few large media corporations, information generated from the media naturally reflects big capitals' interests. Although the internet has provided new information gates through which small companies and individuals have opportunities to send out their own voices, their relative influence is nominal compared to that of the owners of the computer networks. Kmitta (2000) warns of the risk of

information failure, an insidious form of information censorship: That risk increases when the public sphere is flooded with trivial information such as advertising, and risk is highest in allegedly free countries where information is a commodity and thus can be privatized. Media literacy educators have tried to raise people's awareness that the nature of media frequently hinders the free flow of information and prevents true information exchange among people.

Computers connected on the internet have had more media-like capitalistic impacts on people, since possessing computer equipment usually incurs a substantial amount of investments, and using computer networks requires complex cognitive abilities. Therefore, the factors that cause bias in information are more subtle and complicated in the case of IT. Besides, from the information recipients' side, information that flows through the Internet does not grant equal access to the people who cannot afford the physical equipment or lack the cognitive ability to deal with it. For these reasons, media literacy educators have already called for a close co-partnership with computer literacy and information literacy (Considine, 1995).

Problems of Approaching IT Education with a "Literacy" Concept

For some time, researchers have questioned the legitimacy of teaching computers as a form of "literacy." Harvey (1983) is one of the earliest researchers to criticize the popular "literacy" metaphor in computer education at schools. He points out that "literacy" connotes a set of universally required computer skills that everyone needs to master. He argues that it is neither possible nor practical to define a basic computing skill set that everyone needs to acquire, because computers are multi-purpose tools that accommodate various uses. Besides, the speed at which computer technologies evolve makes it almost meaningless to define a set of necessary skills. In addition, the term implies that educational intervention can effectively help everybody to become computer literate at least to some extent.

In spite of the many criticisms of the "literacy" metaphor for computer-related education, the term "literacy" is still being widely used to indicate the basic ability to use IT. Because the deeply rooted connotation of "literacy" is hard to change, other researchers

prefer another term, "fluency." (e.g., National Research Council, 1999; Reffell and Whitworth, 2002)

2.3.3 "IT Fluency" as an Alternative

The National Research Council (1999) adopted a new term "IT fluency" to refresh the focus on users' adaptive understanding and creative application to their work in the changing world rather than simply acquiring computer usage skills. Fluency with information technology is defined as "an ability to use information technology to express oneself creatively, to reformulate knowledge and to synthesize new information." (National Research Council, 1999) It has highlighted more fundamental concepts and capabilities along with specific skills, and identifies three areas of IT fluency: skills, concepts, and capabilities. Skills include such things as using the Internet to find information or setting up a personal computer. Concepts explain how and why IT works. Capabilities include managing complex systems as well as testing solutions, are essential for problem solving. The report points out that many people who currently use IT have only a limited understanding of the tools they use and a belief that they are underutilizing them. It further suggests that more emphasis should be given to the concepts and capabilities, rather than merely to skills. The concept of "IT fluency" is valuable in that it calls for attention to the more fundamental capabilities to deal with continuously changing information technologies beyond some computer skills.

2.3.4 Summary

In sum, teaching computers to students has occasioned discussion among educators for a long time. Many related literacy concepts have been discussed here. Most of them are helpful in understanding peoples' abilities to use computers, but it seems that they are not sufficient in themselves to address the issues of formal IT education in colleges. To understand what the IT programs in colleges are expected to accomplish, it may be valuable to shift attention to students, and to how and why they learn to use computers.

2.4. College Students

2.4.1 The IT-Savvy New Generation

In a large body of literature, younger generation people are typically described as more tech-savvy than older generations. The digital divide literature continuously raises the issue of inequality in accessing IT, and reports one's education level and age are two major factors that make a big difference in people's access to IT (e.g., National Telecommunications and Information Administration, 1999; Hargittai, 2003; Hargittai and Hinnant, 2005).

It is almost common sense that one should learn to use computers before going on the job market. One prominent characteristic of the new generation workforce is being tech-savvy, as they have grown up with information technologies (Business Week, 9/18/2006). Their tech-savviness, along with other characteristics, causes mixed feelings for employers (Kehrli and Sopp, 2006). Employers feel that they do not have to train workers in the basic office tools, but do have to cope with the potential employees' high expectation for IT infrastructure, in order to attract the most competitive applicants. Although it is questionable if the new generation workforce's IT-savviness translates into better work performance, it is still true that they are quite comfortable with IT.

2.4.2 Informal Learning

A significant challenge that the shift from computers to IT has brought is that the technology has become easier to learn. In usability engineering studies (e.g., Nielsen, 1994), learnability, the ease of initial learning, is pointed out as one of the top attributes to consider in designing any user-oriented systems. One consequence that enhanced learnability has brought is that spontaneous learning is greatly encouraged. The dominant mode of acquiring IT competency is spontaneous, informal learning embedded in users' daily activities. Studies of young children's acquisition of IT ability generally suggest that the ability to use IT is usually obtained from informal learning environments outside of formal training or education. Educational psychologists Ching, Basham, and Jang (2005) found that students' age of first encounter with computers "at school" had no significant impact on their range and intensity of computer use later. Rather, their age of

first experience "at home" had a significant influence on the variety of their later computer use. This finding implies that the opportunity to learn spontaneously makes a significant difference later in life. Research on the digital divide in education consistently indicates that owning computers at home results in widely different levels of computer expertise, and that placing computers in classrooms is not very effective in closing the gap (e.g., Nussbaum, 1998).

Although the user-friendly technologies have made learning IT much easier, there are still some difficulties in learning. New IT may have reduced the cognitive complexity of dealing with symbols and representations and complicated technical details. However, as more computers are connected on the networks, they have brought in another dimension of cognitive complexity: users need to understand information attributes that are not directly mapped onto the physical reality, such as web addresses that do not have a one – to-one correspondence with physical locations, the inbox and outbox of email that do not have physical entities, or online relationships that do not necessarily involve any physical contacts with others. IT poses intellectual challenges to users that require them to adopt various meta-cognitive strategies, that is, strategies for controlling and monitoring one's own thinking processes (Smith, Wittman, and Foltz, 2000). Tsai and Tsai (2003) found that students who have higher order meta-cognitive skills in monitoring their comprehension, selecting main ideas, and using resources tend to have higher computer achievement, better computer attitudes, and lower computer anxiety. Especially when an anomaly happens and things that usually have worked do not work, having this competency makes a significant difference.

To cope with those complexities, many studies point out that playfulness and autonomy in the learning experiences are critical, because they allow users to explore and experiment with various possibilities freely on their own. Ching et al. (2005)'s survey results report that college students who had a computer at home before age 10 showed a significantly higher level of computer usage and a broader range of computer-related activities later. Their findings strongly indicate that a learning environment that allows free exploration of many possibilities plays a significant role in learning. Hargittai (2003) also takes autonomy as a crucial condition for learning IT. She defines autonomy of learning as "one's freedom to use the technology when, where, and for what purposes one

wishes." She especially takes work experience seriously in obtaining the competency, as workplaces usually provide users with relatively unrestrained computing resources in terms of the rich equipment and relatively unlimited Internet access. Along with the rich resources, the many opportunities to apply IT to various real work assignments provide practical experience of learning-by-doing, which is not so easily available in any other place. She sees the abundant computing opportunities at workplaces as allowing users to enjoy the autonomy of exploring and playing with technologies.

Selwyn (2003) argues that individuals' level of engagement with computers cannot be sustained if the meaning and consequences of IT use are limited for users themselves. These arguments can be applied to explain the reason that practical objectives in work settings drive the active IT learning that occurs in offices: workplaces are where the meaning and consequences of individuals' competent IT use are well-aligned.

In his subsequent study, Selwyn (2004) identifies the mediating role of different forms of personal capital in shaping people's meaningful use of IT. He argues that one's economic ability to acquire technologies is a necessary condition, but alone it cannot fully explain why people obtain and sustain the competency. Also to be included in the consideration is users' cultural and social capital. Cultural capital denotes the extent to which individuals have absorbed or have been socialized into the dominant culture over time. Social capital means social obligations and connections with their significant individuals, institutions, and organizations that can be called upon. When users are isolated from such capital, they may find it more difficult to acquire competencies and sustain interest over time (Murdock, Hartmann, and Gray, 1996). This finding indicates that why and how people obtain IT competency is a broader question that reaches beyond the scope of formal education.

In contemplating how people learn to use computers, Twidale (2005) pays special attention to users' informal help giving interactions that are frequently observed in workplaces. He calls the mode of learning that occurs in informal help-giving interaction 'over-the-shoulder learning'. The over-the-shoulder learning theory draws on education theories that students learn cognitive skills most effectively through informal, spontaneous learning opportunities embedded in natural classroom settings. These social

learning theories generally agree that interaction within peer relationships is especially helpful when students learn complex cognitive skills (e.g., Vygotsky, 1986; Rogoff, 1990). Other researchers such as Spitler (2005) also point out that a critical part of IT learning usually occurs in social interaction with peers rather than through formal training or reading books and manuals.

2.4.3 College Years: A Transitioning Period from Education to the Real World

I have earlier pointed out that people learn how to use IT informally, often to achieve their own practical objectives. The greater the instrumentality of the IT in achieving their important objectives, the stronger the motivation to learn IT grows. Learning driven by practical objectives is most apparent in the active IT learning that occurs in workplaces. Twidale (2005)'s "over-the-shoulder learning" has been conceived in office work settings rather than in any other learning environments. The reason for choosing offices as a learning setting may be that end users' IT learning happens most actively when users are engaging in computer-mediated work activities. As any type of office work is being performed over IT networks, work requirements strongly shape users' IT learning needs. Hargittai (2003) argues that workplace requirements are a strong motivator that overrides any other variables that affect one's computer usage level. It is well known that elderly people tend to experience greater difficulties in learning computers. She found, however, that the effect of different age groups in computer usage disappeared when she statistically controlled users' computer-related work experiences.

Facer, Sutherland, Furlong and Furlong (2001) point out that there is a fundamental gap between the reason why educators and parents place emphasis on computer education and the reason that children themselves value computer expertise. They argue that while policy makers and parents tend to view computer skills in terms of the children's adaptability to the future world of work, the actual reason that young children value IT expertise is that obtaining the expertise is instrumental in shaping their identity among their peer groups. Peer group values are the major parameters within which children evaluate computer skills. The role of peer groups is especially apparent in boys who acquire the competency to ensure their masculine capabilities such as manipulating machinery and solving computer related problems. A large part of children's computer

learning needs is determined by how their social surroundings value the technological expertise.

Previous studies generally suggest that the immediate value that learners attach to learning computers should be considered in IT education. However, there are not many studies that investigated college students' perceptions and expectations about IT education. What are the practical and immediate concerns that college students have regarding IT education? They are generally known to be the tech-savvy generation. Then is the tech-savviness naturally obtained in their daily lives good enough for them? The answer may become clearer if the three sub-categories that constitute IT fluency are considered. According to the scheme of IT fluency, people may be skillful at using the tools, and they may be competent in doing what they need to do, but still they may lack the concepts for IT, or the capabilities to work productively with information technologies.

Developmental psychologists suggest that college students have different values from those of young children. College students are situated in a transitioning period from education to the real life beyond education. Therefore college years are the time when students make career related decisions. Developmental psychologist Smolak (1993) argues that occupation related values are a significant part of their identity formation in college years. His point implies that the reason that college students would seek formal IT education may be related to their career related plans.

Reffell and Whitworth (2002) provide an explanation that can serve as a common frame to address different populations' motivations to learn about IT. They argue that if de-contextualized IT education is pushed onto learners without fully considering their various reasons for using the tool, it will not be fully assimilated by learners, or may even be rejected. The important parameters that the learners intend to accomplish in their lives should be understood. For young children, such important parameters to accomplish may include peer recognition as previous studies have identified. For college students, such important parameters may include obtaining marketability for the job market, similar to educators' traditional concerns in providing computer literacy education.

Therefore, college students' interest in IT education may come from the requirements of workplaces for new entrants. Computer skills at first were taken as technical skills that would replace the routine tasks performed by humans (Desmond, 1984). In workplaces, competency in dealing with IT continuously degrades unless it is kept up to date. Skills easily lose value unless they are continuously updated. Low-end jobs are continuously being replaced by machine. Already most button-pressing jobs have been replaced by machines. The de-valuation of technical competence is apparent in the changes occurring in telephone customer service: a large part of the service that had been performed by human agents has been replaced by speech recognition technologies. If a job that involves computers such as a cashier's job at a fast food restaurant is still being sustained, it is not because the cashier's skills are so valuable, but because customers strongly prefer interacting with humans.

A more fundamental reason for job seekers to rely on higher education to obtain the competency they need may be related to the fact that skill acquisition is no more sufficient to obtain the advantages that computer literacy education had brought before. Now all the innovations and changes capitalize on tacit, idiosyncratic, and context-specific knowledge which is generated and delivered on computer networks (Hodgson, 2003). Having computer skills itself is no longer advantageous in obtaining highly respected or better paid jobs, as practically any kind of job requires the ability to effectively use IT. Employers now want employees to have cognitive competence, as well as technical IT skills, because workers' competent mediation is necessary to generate value from intangible knowledge assets (Levy and Murnane, 2004).

2.4.4 Summary

Many college students, if not all, are adapting quite well in their increasingly technology-centered lives. They are known to be a group that is competent in using various information technologies for their own purposes. Then some questions occur. What are they not good at, in terms of preparing what they need? What is the place for formal IT education for them?

Learning IT occurs primarily in every day lives, in social relationships, through informal learning methods, and in order to achieve important practical objectives. As for the

learners, the primary reason that they desire formal instruction, especially in higher education, may be that they take what they study in colleges as a form of certified IT competency, which is instrumental in obtaining a more advantageous position in seeking better jobs and future economic advantages. Requirements for higher-order thinking skills make IT competency seem a suitable topic for higher education to deal with.

3. METHODOLOGY

The purpose of this chapter is to describe how the research was carried out to answer the research questions in this study. This chapter includes the following five sections: overall research design, description of the research setting, research procedure, participant profile, and data analysis.

3.1. Overall Research Design

This exploratory study took a qualitative approach for data collection and analysis. Qualitative methods are effective when describing complex phenomena, illuminating experience, and interpreting events from informants with widely differing stakes and roles (Sofaer, 1999). Creswell (1994) argues that the characteristics of qualitative research are embedded in the characteristics of research problems. Those research problems involve first, immature concepts owing to a visible lack of theory and/or previous research; second, a notion that available theory may be inaccurate; and third, a need to explore and describe the phenomena and to develop theory (Morse, 1991). Nasser (2001) also recommends that researchers use a qualitative approach when there is little information available about the topic, the involved variables are largely unknown, the context is important for understanding the phenomenon under study, and a theoretical basis does not exist or is not sufficient, so that the research problem needs to be explored broadly.

Most of those conditions that require a qualitative study are true for the issues raised in this study. Students' perspectives on the new type of IT education are not well-known. The associated variables that influence their perceptions and expectations are not known either. The contexts where the students needing formal IT education are situated are diverse, and a theoretical framework that directly addresses the issues does not exist. Hence there is no specific theory to be confirmed through this study. Therefore, this study followed the grounded theory approach suggested by Glaser and Strauss (1967). The grounded theory suggests some analytic procedures aimed to develop a middle-range theory to explain behavior and processes from a logically consistent set of data collection

(Charmaz, 2001). A grounded theory study is conducted to discover a theory as it emerges from data gained from the study participants (Nasser, 2001). It is a process of conducting theory construction inductively. Inductive theory research begins by constructing a theory through the inductive method by observing aspects of social behavior and then seeking to discover patterns that may point to relatively universal principles (Glaser and Strauss, 1967).

This study explored the research questions mainly with undergraduate students who were enrolled in courses in an IT minor program. Some of them were taking an IT class to pursue the IT minor, and others were taking one for other reasons, such as fulfilling their general education requirements or pursuing their personal interests. They had various backgrounds, in terms of their everyday IT uses, overall competencies in dealing with IT, earlier experiences with IT when young, family environment and academic backgrounds, etc. They were most apparently different in terms of their majors. Generalizing how college students across different backgrounds perceive the needs for formal IT education is not a main focus of this study. Rather, it is those diversities that are of great interest. Therefore, this study was intentionally designed to address the diversity in exploring students' perceptions and expectations about an IT program. A qualitative approach is a good fit for this investigation, as qualitative data usually provide rich descriptions and explanations of processes in identifiable local contexts.

In-depth interviewing was chosen as a data collection method for this study. In-depth interviewing has been understood as one of the most powerful ways to learn other people's perspectives (Fontana and Frey, 2000). Seidman (2006) argues that listening to people's stories about their lives is an effective way of knowing and understanding their own worlds. He views that an interest in understanding the lived experience of other people and the meaning they make of that experience motivates researchers to conduct in-depth interviewing. He continues that interviewing provides access to the context of people's behavior and thereby provides a way for researchers to understand the meaning of that behavior. When the researcher's ultimate goal is to understand their "subjective meaning," interviewing is the best avenue of inquiry (Seidman, 2006). This study is interested in learning college students' own perceptions and expectations for IT education at a college level, while taking their backgrounds, past experiences, attitudes, and current

concerns into consideration. To this end, I chose qualitative interviewing as the most appropriate method to achieve the objectives of the study.

This study used a semi-standardized interview format. This type of interview involves implementation of a number of predetermined questions and special topics (Berg, 2004). The questions are typically asked of each interviewee in a systematic and consistent order, but still the interviewer has freedom to probe far beyond the answers to the prepared questions. One major purpose of this study is to compare different students' perceptions regarding college-level IT education. An interview with some degree of structure will make comparison easier.

Although qualitative interviewing is more flexible to different people and open to any emerging topics, sometimes college students may not be very good at articulating what they perceive they need for their lives within and beyond their formal education. Therefore, it is necessary to prepare a question set that consists of well-prepared questions to probe their thoughts effectively. To that end, a semi-structured interview was planned to obtain data for this study.

3.2. The Research Site

Qualitative data collection is carried out in close proximity to a local setting, as a qualitative study tries to understand perceptions of people in relation to their significant experiences within the research site (Miles and Huberman, 1994). This study tried to understand the perceptions of undergraduate students in relation to their subjective experiences in an IT program. Therefore, in this section, the IT program that was the research site of the study is briefly described.

The interview data was collected from an undergraduate IT minor program at the University of Illinois at Urbana-Champaign. Previous studies on IT education have broadly identified two different types of IT programs. One group is the IT programs organized by educators in the traditional computing fields, and the other is the IT programs organized by educators from more diverse disciplines that span across the

Humanities, Social Sciences, and the computing disciplines. The IT minor program studied here is close to the second type.

This IT minor program was launched in the fall of 1999 with the name "Information Studies" minor. It started with the initiative of the Library and Information Science program of that institution, in collaboration with the Communications program on the same campus. In the following year, it changed its name into "Information Technology Studies" minor to reflect the nature of this new minor program more accurately. By being set up as a minor, rather than being a standalone college major, the IT minor program intended to offer IT education to diverse student populations on campus regardless of their academic backgrounds. The primary purpose of the IT minor program is to help students obtain fluency with information technologies in addition to their basic information technology skills (Information Technology Studies Minor at the University of Illinois, 2003). The minor is open to students from any major, although with slightly different requirements. It requires 18 hours of coursework including a couple of core courses. Most of the courses in the IT minor program are open to non-minor students, as well as to students actually enrolled in the minor. The introductory IT classes of the program satisfy the campus general education requirements.

Official enrollment statistics of the IT minor are not available. According to an internal report compiled in the year 2005, about 50 students were enrolled in this minor each year. Since its launch, typically 4-6 undergraduate IT courses have been offered each semester. Students from various disciplinary units on campus have enrolled in the courses in the IT minor program for the past few years. Students who have been in the IT classes were from various backgrounds. In the first year of the program, students who came to the IT classes included majors in Media Studies, Graphic Design, Mathematics, Speech Communications, Business, Psychology, MIS, and English (Haythornthwaite, 2000). These students had future careers and graduate work planned in as diverse fields as Library and Information Science, Computer Science, Human-Computer Interaction, Medical Science and Technical Writing. The size of enrollment in the IT minor peaked in the year 2003 and then has been steadily declined until the year 2008. In the Fall 2008, the IT minor had a new start as a campus-wide minor. In the process of being transformed as a campus-wide minor, it took on a new name "Informatics" minor, and

has restructured its curriculum. The mission of the redesigned IT minor program has been more elaborated from that of the former IT minor. Its primary purpose is helping college students use computation to solve problems, to communicate, and to express ideas in their majors and other fields (Illinois Informatics Institute, 2008).

3.3. The Research Procedure

3.3.1 Sampling

Undergraduate students who were enrolled in one or more courses in the IT minor program were the main target of this study. The purposive sampling method was adopted to obtain participants for the interview. Purposive sampling is "a non-probability sampling procedure that involves selecting elements based on the researcher's judgment about which elements will facilitate his or her investigation." (Adler and Clark, 2003; p130)

Fundamentally, the focus of this study is exploring students' diverse interests and concerns about their IT competencies and expectations about IT education provided by colleges. Enrollment in an IT course was taken as evidence that indicates students' interests in the IT program. Sampling was made so that the interview participants included as diverse students as possible, especially in terms of their major. Miles and Huberman (1994) write, "sampling in qualitative research involves setting the boundaries to define aspects of your cases that you can connect directly to your research questions, and that will include examples of what you want to study."

In the IT minor courses, there have been only a small number of students in the courses who are from traditional computing majors such as Computer Science and Computer Engineering. The number of students who are from engineering fields has also been relatively small, a group that is of equal interest as Liberal Arts majors that constitute the majority of students in the classes. Therefore, these types of students were particularly encouraged to participate in the interview when invited.

Interview participants were recruited from the IT minor courses offered during the Spring and Fall 2007 semesters. I contacted instructors of several IT courses first to obtain

opportunities to recruit interview participants from their classes. Those IT courses included LIS 202 "Social Impacts of Information Technology," "LIS 310 "Computing in Humanities," LIS 390 "Information Organization in Everyday Life," LIS 451 "Introduction to Network Systems," LIS 490 ITU "Entrepreneurial IT Design," and LIS 491 "Literacy in the Information Age." The first three classes were open to undergraduates only, and the other classes were higher level classes that are open to both undergraduate and graduate students.

Upon the instructors' understanding of this study, I visited the IT classes and gave students a brief introduction to the study. After explaining the purpose and the procedures of the study, I asked students to sign up for an interview session if they were interested in discussing the topics. The students who signed up were contacted to arrange an exact time and location to have an interview. Each participant who signed up for an interview received a reminder via email and phone before the previously arranged interview time. Participation in the interview was made on a voluntary basis. Neither extra credit nor financial compensation was offered to solicit participation in the study.

A concern that students who have not taken any IT courses may have significantly different perspectives about college IT education was raised during the research design phase. Therefore, an attempt to include undergraduate students who had not taken any IT courses was made as well. Identifying students who do not have experience in IT classes but are "potentially" interested in the IT courses is not easy, as there is no actual listing of such students. A snowball sampling method was tried to recruit students of this type. A snowball sampling method is a sampling method that uses members of the group of interest to identify other members of the group (Adler and Clark, 2003; p131). It is a useful way to obtain participants in a case where population listings are not available. At the end of each interview session, the interview participants recruited from IT courses were asked to name one or two of their colleague students who had not been enrolled in any IT minor course but might be interested in taking such a course. The referred students' names and e-mail addresses are obtained from the online public student directory available at the university's website. An email invitation was sent to 15 students. The e-mail messages introduced the purpose of the study and asked about their willingness to participate in the study. No positive response for participation was returned

in the first round. I sent out a second round email invitation one week later. Two students finally agreed to participate and were interviewed. Overall, the e-mail invitation did not work well in this study, probably because people these days live in a flood of information and are not willing to respond to an invitation email from a stranger.

The number of total participants was 28. Seidman (2006) suggests two criteria for determining the number of samples in a qualitative study. One criterion is sufficiency. As the participants were recruited from 17 different majors from the Humanities to engineering, I determined that enough major areas were included. The other criterion is information saturation. When a researcher starts to hear the same information and no longer learns anything new, it is a time to say "enough." When the number of interviewees reached 28, I stopped recruiting additional participants following his suggestion. The participants included students enrolled in the IT minor, students who took IT classes for other reasons, and students who had not taken any IT classes.

3.3.2 Interview Procedure

All the interviews were conducted face-to-face. Most interviews were conducted in a small conference room or in a small lecture room in a campus building where the IT minor program was housed. When an interview participant could not come to the building because of a scheduling conflict or other reasons, another private office in other buildings on the campus was arranged. Each interview session lasted about an hour. The shortest interview took 46 minutes, and the longest one lasted 85 minutes. In each interview session, a participant received a written consent form approved by the Institutional Review Board (IRB). The major purposes of the consent form were to certify if they agreed that the interview session be audio-recorded, and if they were 18 years old or older. The participant read and signed it before proceeding to the interview. Before signing the consent form, the participants were asked if they had any questions regarding the interview. Most of the questions that they had were answered before proceeding to the interview.

This study is intentionally open to students' emerging interests and considerations. Although I used a pre-determined question set, I changed the exact wording of the questions so that the questions could be more suitable to each interviewee. The interview

questions were adapted flexibly to facilitate further elaboration as interesting issues began to be mentioned by the interview participants. For example, when a participant started to talk about another student who was very knowledgeable about the content of the class and expressed her envious feelings while talking about her IT classes, I let her talk more about her feelings instead of proceeding to the next question.

This investigation also changed the order of questioning sometimes to facilitate conversation. My experiences as a teaching assistant in prior introductory IT classes could be a shared understanding with the students, upon which further conversations could be built. Therefore, I began most interviews with questions that asked about their experiences in IT classes to facilitate conversation based on shared experiences and understanding. For students who had not taken any IT classes, questions started with their computer use in school and their everyday lives.

All the interview content was audio-recorded. Adler and Clark (2003) suggest that the more unstructured the interview, the more necessary audio-recording becomes. Seidman (2006) points out that a recording device may seem to inhibit open conversation, but the existence of the device is soon forgotten in most interviews. I explained the purpose and benefits of audio-recording to the participants before proceeding to the interview. Because all the conversations were being audio-recorded, I was able to concentrate on listening and preparing the next questions without a need to take notes on all the variations of each interview.

I transcribed all the interview recordings for further analysis. Seidman (2006) argues that all the in-depth interviews should be transcribed word by word, because every word that a participant speaks reflects his consciousness. He warns that paraphrasing or making summaries may lead to researchers making premature judgments about what is important and what is less important. Preserving the words of the participants enables researchers to have their original research information and be able to go back to the original data and check accuracy whenever something unclear comes up.

I transcribed all the audio-recordings by myself, and there was no one else who listened to the recording of the interview. I used pseudonyms to identify interviewees in the transcribing process and analysis to protect their identity. The pseudonyms reflected their

gender though, as previous studies suggested that there may be significant gender differences in the perception about IT education. No personally identifying information about the interviewees was disclosed in any written documents.

As I had been involved in the IT minor program as a teaching assistant in the introductory classes for the past couple of years at the time of the interview, I had prior acquaintance with many interviewees. They knew that I was a doctoral student and was involved in IT education in some capacity. As the interviewees knew my position, they were willing to talk and convey their honest thoughts about the IT program. Also, shared past experience facilitated the conversation.

Although an interviewer focuses on how participants reconstruct their experience and make meanings, interaction is inherent in the nature of interviewing, and interviewers are also a part of that process. Rather than trying to strip the influencing factors, Seidman (2006) recommends that a qualitative researcher recognize and affirm the role of the interview instrument, the human interviewer. The meaning collected is a function of the participant's interaction with the interviewer. I tried to minimize the distortion, by recognizing the interaction and affirming the possible consequences that the relationship might have brought.

Special attention was given for interviewees to minimize any "conflicts of interest." Qualitative researchers warn about the negative consequences of the power imbalance between interviewers and interviewees, especially when they are teachers and students. When studying students, a student can hardly be open to his or her teacher because the teacher has much power in the relationship. I was working as a teaching assistant in one of the IT classes at the time of the recruitment. To recruit participants from that particular class, additional cautions were given: 1) recruiting in that class was made after participants had been recruited from the other IT classes, and 2) students were clearly informed that the rest of the course work of participating students would not be graded by the researcher. Those students' papers and exams were graded by another grader of the course.

3.3.3 Interview Guide

An interview guide is "a list of topics to cover and the order in which to cover them that can be used to guide less structured interviews."(Adler and Clark, 2003) An interview guide that covers the major issues of this study was developed. The interview guide consisted of several broad issues raised in the research questions:

- Reasons for taking an IT course
- Perception of their own IT competencies
- Sources for help in learning IT
- Work experiences that involve IT use
- Awareness/interest in the IT minor program
- Topics that they expect in the IT program
- Current majors; and concerns and interests in their current majors
- Future career plans and job interests

Following these broad thematic issues, a list of questions for each category was developed. A draft of the interview guide was developed by compiling the question lists.

After developing the draft, I had it reviewed by area experts for an expert review. Berg (2004) recommends that researchers go through an expert review procedure after an interview instrument is developed, to assess how effectively the interview will work and whether the type of information being sought will actually be obtained. Following his recommendation, the interview guide was examined by experts who have substantial experience of interacting with students in the IT minor courses. These experts included two faculty members who have served as an instructor in the IT minor courses. Through this expert review, I fixed poorly worded questions and questions that revealed my own biases and blind spots.

After the expert review, I conducted two pilot interviews with students who took some of the IT minor classes. The two students who participated in the pilot study were similar to interview participants, in that they were undergraduate students who had experience in

one or more IT classes. After conducting the pilot interviews, I changed the wording of some questions to convey the intent of the questions more accurately. Questions that turned out to be unnecessarily detailed were simplified. The sequence of the questions was adjusted in order to make the conversation flow more naturally. Finally, a few questions that the pilot participants did not understand were removed. The interview guide used in this study is presented in Appendix A.

3.4. Participant Profile

A total of 28 interviewees were recruited. Among them, 26 interviewees were recruited from one of the IT classes. Two interviewees were recruited outside of the IT minor program. The two outside participants have not taken any IT class. When the total number reached 28, I determined that additional participants would not add a significant amount of new information.

Among the 28 participants, 16 students were males and 12 were females. The majors of the participants varied in a wide range. Participants were from 17 different majors: Accounting, Advertising, Aviation, Chemical Engineering, Computer Engineering, Computer Science, Economics, English, Finance, History, Journalism, Management Information Systems, Media Studies, Philosophy, Political Science, Psychology, and Sociology. 16 students were pursuing the IT minor. Among the other 12 students, 10 students had taken at least one IT class. The other two students had not taken any course in the IT minor program. English majors were the majority; 6 English majors were interviewed.

There were 3 sophomores, 9 juniors, and 16 seniors. Since the IT courses require a sophomore standing as a prerequisite to enroll, all the interview participants were at least at the sophomore level, and therefore did not include any freshman students. More seniors were included than sophomores and juniors. The reason was that most of the IT classes from which interview participants were recruited were upper level undergraduate classes. Two of the upper level classes were open to both undergraduate and graduate students. In those classes, seniors were the majority among the few undergraduate students. The three sophomores included in this study were recruited from an

introductory IT class. Only one introductory IT class was being offered during the recruiting period. The advanced nature of most IT classes offered during the recruiting period was the main factor that resulted in the interviewee group skewed towards juniors and seniors. This remained as a limitation of this study, in that freshmen and sophomores may have different thoughts about their college education from those of juniors and seniors.

The majority of the students had followed the traditional academic track, both in terms of their age and their relative position within the college student population. All the participants signed a consent form that affirms that they are 18 years old or older. There was one atypical student who was a returning student from the navy and was much older than the other participants. Such an anomaly was revealed while talking about topics like class experiences and their choice of majors during the interview session. The detailed profiles of the interview participants and the distributions of the participants over several major dimensions are summarized from Table 1 through Table 6 in Appendix B.

Extended descriptions of selected participants are included in the last section of this chapter. The four selected participants introduced in the description had markedly different interests regarding IT education. They also had different backgrounds that might have contributed to those diverse interests. They do not represent all the 28 participants exhaustively. Rather, they are introduced to provide a vivid portrait of the study participants and to highlight the diversity involved in their interests.

3.5. Data Analysis

The analysis followed the steps in the grounded theory approach suggested by Glaser and Strauss (1967). The hallmark of a grounded theory study is deriving analytic categories directly from the data, rather than from preconceived concepts or hypotheses (Charmaz, 2001). By using this approach, the researcher expected to develop a theory or a model that explains students' perceptions and expectations about IT education, as it emerges from the information that the participants provided.

After the interviews were transcribed, codes that categorized the interview contents into theoretical categories were developed from the transcripts. In a grounded theory approach, codes to reduce the data emerge from the data, rather than from previous studies or pre-determined concepts. The codes were used as foundation blocks to develop a theory in the later stage.

To create meaningful codes, line-by-line coding was performed first. Line-by-line coding means naming each line of data (Glaser, 1978). The purpose of this line-by-line coding was to keep the researcher closer to the data and take an analytic stance towards the work and help understand the participants' interpretations which may differ from the researcher or the previous research (Charmaz, 2001). The line-by-line coding gradually shifted to focused coding as the data analysis went on. Focused coding refers to taking earlier codes that continually reappear in the initial coding and using those codes to sift through large amounts of data. In this phase, initial categories were elaborated into more conceptual categories. A small number of interesting line-by-line codes, which made the most analytic sense and categorized the data in a most accurate way were taken. The categories were as conceptual as possible while simultaneously remaining true to and consistent with the data.

Memo-writing followed the focused coding as the next step. Memos are the researcher's record of analysis, thoughts, interpretations, questions, and directions for further data collection (Strauss and Corbin, 1998). Charmaz (2001) explains that memo-writing is the intermediate step between coding and the first draft of completed analysis of the data. She suggests that by the time a researcher starts to write memos, the researcher begins to look at the coding as processes to explore rather than solely ways to sort data into topics. Therefore, by conducting memo-writing, I identified the broad patterns to form a theory beyond the individual cases.

Theoretical sampling was conducted along with memo-writing. Theoretical sampling indicates the process in which a researcher samples the parts and topics of the data, which will clarify the research ideas and fit them to a theory. It provides "a way of checking on the emerging conceptual framework." (Glaser, 1978; p39) The decision on which parts and issues to include is guided by concerns of the emerging theory's relevance (Emerson,

2001). The major themes were identified by following the steps described above. The topics discovered from the interview data were grouped into 6 main themes, which became the foundation for organizing the results chapters that documented major research findings.

3.6. Extended Descriptions of Four Selected Participants

3.6.1 Janet: An English Major Focusing on Learning Technical Skills

Janet is a senior in English. She is pursuing the IT minor along with her major. She started to take classes in the IT program in her sophomore year after learning about the IT program from her advisor in the English department. After she heard about the IT minor, she took her first IT course to see if she would like it. After finding the class interesting and useful, she decided to continue and declared the minor in the following semester. So far, she has completed 5 IT courses, and currently is taking her 6th IT course. She is planning to pursue a job in the publishing field.

Janet's use of information technologies in everyday life is very intensive. She especially uses communication technologies a lot to talk with her friends. As she uses computers all the time, she feels that using computers has become an indispensable part of her everyday life. She actively utilizes information technologies for her general school work as well. She finds Moodle, a popular open source course management system, and Compass, a classroom support system customized for this university, very convenient and useful. As many of her classes give homework assignments through these course support technologies, she has become accustomed to the practices of carrying out many course-related activities on computers. She has a very positive attitude about the adoption of various technical innovations to school practices as she has found many advantages of utilizing computers.

Janet also believes that she has basic technical competency for working with computer-related problems. When she gets a new IT device or a new software application, she prefers to try it out by herself first, because she has found from her past experiences that most computer applications actually are not too hard to learn. She is also very confident

about her self-learning ability of finding a solution from the Internet when a computer problem occurs. When the problem to work with is very technical, she usually finds somebody to ask for help.

Janet has used computers intensively since she was very young, as her family always has had home computers since as early as she can remember. When young, she used the home computers mostly to play CD-Rom games. Along with the games, she occasionally used the computer to type up her homework. After her family got an Internet connection later, she started to do Internet searching for her homework in high school.

In the IT program, she had chosen mostly technical classes which teach hands-on technical skills. As the technical hands-on computer skills are very novel to her, she feels that learning these technical skills would be more useful to her than discussing social implications of IT. She feels that web technologies and database knowledge are very useful for her, because she has been very much interested in learning how to make interactive web sites and how to design usable interfaces for general users. So far, she has been happy with what she has learned in the IT program.

Her current interest in learning IT is closely related to her career considerations. She wants to get a job in the publishing field. From her job search in this area, she has found out that the publishing field is more competitive than she expected and very hard to get into. The biggest challenge is that this field has only very few job openings and requires a lot of work experiences even for recent college graduates who are aiming at an entry-level position. As she finds the job search process is harder than she expected, she is desperately looking for a way to make her qualifications unique among the candidates with similar abilities. She chose the IT minor as a way to supplement her major in English, as she thinks that IT skills and knowledge are a very different set of abilities from that of typical English majors. She feels that having enough technical grasp would be her biggest challenge to continuously grow in the publishing field that is rapidly changing with the IT innovations.

3.6.2 Dave: A Political Science Major Who Loves Utilizing Information Technologies

Dave is a senior in Political Science and is pursuing the IT minor. He learned about the IT program from his counselor in the Political Science department while talking about the

different ways to fill his 20 hours of supporting coursework requirements. He generally likes to use computers and other IT devices in everyday life. He also enjoys talking and writing about diverse IT topics. Therefore, he thought that doing the IT minor would be a great way for him to fulfill the requirement. He is planning to pursue a government job after completing his undergraduate work in Political Science.

Like Janet, Dave's use of information technologies for social purposes is very intensive. He is a transfer student who came from another state, and has many friends at a distance. Therefore, he intensively uses instant messaging services (IM) among many communication technologies, because IM serves his specific communication needs better than other means of communication. For his school work, he enjoys using various class technologies. As one who enjoys using technologies very much, he is very happy that many convenient class management technologies are being introduced to school settings.

Dave feels that he is very good at dealing with information technologies in general. His judgment is based on his role as a "tech support guy" among his housemates. His housemates always consult him about technical issues such as TV settings, network settings, and Xbox game device settings. Because he likes to work with technologies, is good at dealing with technical problems, and is able to provide technical support to his friends, he feels that his overall competency of dealing with IT is generally high.

Dave has had a home computer since he was 8 years old. He has played with the computer a lot since then, playing games like Solitaire. He says that his parents must have gotten the computer for him primarily for his education, but for him, it was more about gaming and other fun activities. Dave feels that his inherent interest in IT is definitely his mother's influence, who works as a computer analyst. His mother did not get any formal education in Computer Science, but picked up the different computer skills while switching between different government positions. Now she is playing a critical role in an IT department of the state government. He often has conversations with his mother on different technological topics.

Although Dave has always liked playing with information technologies, he has never thought of computing as his possible career choice, because he has not liked programming at all. He took a Java programming class in high school because he had

always been interested in using computers. However, what he found from that class was that he hated programming. Besides, he has always considered himself a "people person," who has a talent of bringing people together. For him, a computing career is not very attractive because he considers that working in the computing field is solitary, and would not allow him to interact with other people.

The number one interest in the IT program for him is that he can talk about information technologies without being required to do programming. Especially, he found that IT classes that discuss social impacts of the Internet to be very interesting. He found these classes interesting because they deal with what he frequently experiences in his everyday life. He was glad that he can relate the class discussions to his own experiences in his daily life.

Currently he is pursuing a government job. As a lover of technologies, Dave wants to get a position that has to do with IT in some way. Although he knows that his lack of programming experience may cause some problems in getting such a position, he still hopes to get a position where he can utilize diverse technologies and closely interact with IT people.

3.6.3 Brad: An Economics Major Who Focuses on Learning about Social Contexts of IT

Brad is a senior in Economics. Throughout his college life, he has had a feeling that understanding how information technologies influence people and the society is very important. He also has a slight desire to see how various technologies are being utilized in workplaces. However, he is hesitant to jump into taking the IT minor, because he has not liked dealing with any technological applications in general. In choosing a class in the IT program, most IT classes sounded too technical to him, and he picked an IT class that deals with social implications of IT, which sounded less technical. He is currently hoping to get a job in the commercial banking field.

Brad acknowledges the importance of learning computer technologies, but has always believed that he is not as adept at dealing with computer technologies as most of his peers. He rates his skill level as "the lowest 2%" among his peers. He thinks that way because

he does not have any technical skills and rarely has had any personal interest in learning technological topics.

In spite of his low self competency rating, he actually uses IT as intensively as other students. He uses an instant messenger to talk to his friends and exchanges text messages on his cell phone, although his use of technologies may be a little less frequent than other students. Like many other students, he is very much used to using IT for his school work. He does not have any problem utilizing various technologies used for school work. He feels that most recent class supporting software is self-explanatory and easy to figure out. He usually downloads class presentation slides and studies with the study materials at home. He is so used to using online class materials for his study that he expresses complaints about some classes that do not put the class slides online.

In spite of his lack of interest in computers, he has taken an introductory Computer Science class offered for non-technical majors. That CS class is required for his concentration area of Business within his major in Economics. Although he feels that he has gained very useful knowledge from the CS class, he never has enjoyed that class.

Like many other students, Brad's family had an home computer when he was young. However, getting the most up-to-date technical equipment has never been a priority to his family. He feels that this family atmosphere has influenced his lack of desire about utilizing computers. As an accountant, Brad's father has worked with computers all the time, but has never been passionate about acquiring the newest technical gadgetry. Partly due to this family atmosphere, Brad always has been slower than his peers in embracing new technologies. However, he usually plays a role of introducing new technologies to his family. For example, when he went back home for a Christmas break, he found that his parents got a new high definition TV. However, it was not connected to the digital cable service until Brad came back home and set up the connection.

Although Brad has not liked working with technologies, he has liked learning how people use computers and the Internet and how those technologies affect people. Before choosing the IT class, he took a Communications class that dealt with how different types of media such as TV and Internet affect society and different groups. That class appealed to him because that class looked at the impact that different media had on society, rather

than how the technologies actually work. He found that the class content was interesting and important, and expected that the IT class that he chose would be fairly similar. While he thinks that most IT classes are too technical for him, he is interested in some other type of IT classes, like "Literacy in the information age," and "Legal and ethical issues."

Besides, Brad is very eager to acquire more advanced Excel skills. During his job search, he has realized that proficiency in Microsoft Excel is required for most positions in the commercial banking field. As a senior, he regrets that he has spent his college years mostly for fun. For Brad, knowledge of IT, especially that of Excel, is not necessarily something he wants to learn from his inherent interest, but is something that he hopes to master before being placed in the real world of work. That way, he hopes that he can start playing active roles right away, instead of spending time to receive training for basic workplace skills. Besides, he feels that how to setup a web site is necessary knowledge to everyone living in the contemporary time, if not in a career sense. Therefore, he is willing to learn the basic web design skills when time allows.

3.6.4 Zachary: A CS Major Fulfilling His General Education Requirements with IT Classes

Zachary is a senior in Computer Science. He is not pursuing the IT minor, but is taking his 2nd class in the IT program. The two IT classes would fulfill his 6 hours of general education requirements for Social Sciences. He picked the IT classes from a list that fill the general education requirements for engineering students. He really wanted to take social science classes that are related to his major, rather than classes that are totally unrelated. In particular, he wants to learn how what he has learned in CS can be integrated into workplaces, rather than to discuss how people use popular technologies such as e-mail and what their social ramifications are. He has not seriously considered about a possibility of doing the IT minor, because his tight class schedule in the college of Engineering does not allow him to take extra classes outside of his major.

Zachary has had a lot of exposure to computers since he was young. His father was an accountant and worked with spreadsheets all the time. His father was a busy person and sometimes brought his work home. Zachary feels that his earlier experience of watching his father working with computers was what eventually brought him into the CS field. He

spent many hours playing various games on his home computer. His great interest in playing games has naturally developed into a desire to learn programming to make those games by himself. As he says, programming was "the next step" for him. When his parents bought a computer for him and enrolled him in basic programming courses, he instantly realized that he could do something interesting with the programming language. He already has taken many programming courses in high school, and that well-paved his way into the computer science field.

Not surprisingly, he points out that some technical topics in IT classes are too easy for him. Nevertheless, he liked the IT classes because he had more fun in IT classes than in Computer Science classes. He also feels that he has learned something more useful and practical in an IT class than in most CS classes. He especially enjoyed a class project in which he developed a working website with other students in a group, even though as a CS major he already knew enough about how to build a working website. For example, he had a Graphic Design major in his term project group, and he learned useful web design skills from her. He is using the design knowledge for his portfolio to prepare his job application.

Zachary's focus is strictly on programming, which he believes is "what Computer Science actually is all about." He considers that "IT work" is very different from "programming work." He argues that IT work is not a programmer's job, but is a computer technician's job. He points out the fact that companies even hire separate IT support people to assist their programmers. He strongly hopes to be one who does programming, not the one who provides technical supports to other people.

Although he does not want to be engaged in any type of IT work as his job, he admits that IT work is something that he will have to confront in the future anyway, if he likes it or not. He recognizes the significant challenges that computer science people are facing. He feels that the intensive CS training is usually focused on fundamental principles of computing, but does not teach other important skills such as communication skills and organization skills, which CS students would need to acquire when they try to integrate their academic training into practice.

Contrary to the common sense that there always are many computer jobs, he believes that the job market for CS majors is becoming tighter and tighter. He feels that the job market has not grown much, compared to the increase of the number of people who seek a CS job. Currently he is interviewing with a couple of big IT companies to launch his career as a professional programmer.

4. COLLEGE STUDENTS' OVERALL HIGH COMPETENCY PERCEPTIONS IN INFORMATION TECHNOLOGIES

Learning often occurs when a learner recognizes a gap in his or her current knowledge status. If college students feel that there is a gap in their skills and knowledge of IT, the gap may lead them to seek an opportunity for formal education in IT. Therefore, as a starting point for the overall investigation, students' self perception of their own IT competency is explored. College students' overall high competency perceptions in information technologies have emerged as the first theme of this study.

4.1. Descriptions of Students' Self-Perceived IT Competency

Participants' self-perceptions of their IT competency were investigated first by examining their answers to an interview question that directly asked them if they thought they were good at dealing with information technologies. The specific question was, "do you feel generally good at dealing with information technologies?" In general, participants' responses to this question were positive. The ways in which each participant responded to this question varied, as some participants instantly said yes to this question, and others showed some hesitation before providing a positive answer. However, most participants, except for a few, eventually answered yes to this question. Example answers of the participants who instantly answered yes are presented here. Andy, a Political Science major, answered:

> Oh, certainly, yes.

Janet, an English major, responded:

> In everyday life, yeah. I use them a lot. I use my computer all the time.

Jack, an Advertising major, answered:

> I think so. I am one of those people who is constantly glued to email.

Not unexpectedly, those who answered yes to this question included participants from technological majors. Most participants from technological majors instantly answered yes

to this question without hesitation. Big laughter often accompanied their positive answer, signaling that they took their technical competency for granted. Here are their responses. Eric, a Management Information Systems (MIS) major, said:

> I hope so, hahaha...Yes, I would say so.

Nathan, a Computer Engineering major, responded:

> Yes. Hahaha....

Zachary, a CS major, said:

> Um... yes.... Hahaha...

Some other participants who were not technological majors showed some hesitation before answering the question. However, they eventually answered that they were generally okay. For example, Jenna, an English major, answered:

> Um... in what...? Yeah, I use the computer pretty much for everything for school... ... I would say everything is online..... I never write a paper anymore and turn it in. And I even print-out my notes... everything's done with computers.

Aaron, a History major, answered:

> I think so... I am trying to think because there are so many different IT out there... um... I am pretty comfortable using computers in general.

Kate, another English major, answered:

> Umm.... Generally good, yes.

The ways in which the participants answered the question varied, but overall, a positive answer was common among the majority of the participants, which indicated that they perceived that their overall IT competency was okay.

4.2. Possible Contributing Factors

From the participants' descriptions of their past experiences with IT in the other parts of the interview, several factors that may have contributed to students' overall perceptions of high self competency in IT were inferred.

4.2.1 Intensive Use of IT in Everyday Life

Most participants indicated that they were using information technologies intensively in their everyday lives. As college students, their IT usage was embedded in various spheres of their college life. Two major purposes for which they used IT intensively were handling their everyday school work and communicating with other people.

One area in which participants used IT intensively was their school work. Most participants indicated that they were using IT actively for their various class activities. The university environment in this institution provides an intensive computing infrastructure to the employees and students to facilitate education and research. The university's library has adopted many ways of delivering library resources electronically. The university also provides various tools for class communication, which many classes utilize to support their class administration. In this IT-heavy school environment, use of computers for school work is rather taken for granted. Besides, school technologies are usually designed for ease, so that they can capitalize on students' current level of IT competency acquired from their past experience. Therefore, most participants indicated that they were utilizing IT for school work very intensively without having much difficulty. A comment from Tom, a Psychology major, showed how the increasingly IT intensive university environment engages college students in extensive IT uses in college.

> Being a college student right now, you have to be able to use all kinds of technology, whatever it is thrown at you. I work here, so I have to do certain things here. Professors in classes say "you need to do a project, and it needs to be on this." And you're like, I don't know what that is, so you have to figure it out ...

Course management systems that were widely used to support class activities were pointed to as a major factor that made participants use IT intensively for their school work. Janet, an English major, found popular course management systems being utilized in many classes very convenient. She reported that many of her classes were assigning homework to students through those course management technologies, and consequently she became very accustomed to the practices of utilizing those technologies.

> Yeah, I do actually [feel comfortable about using IT for school work]. For example, my Physics class that I have, we do have homework online every week. You just login to the system, and you answer questions and hit submit, you have until like a certain deadline, so I have that. And there's Compass, we use Compass in one of my classes, where they just post an announcement which is really helpful ...

Participants' attitudes towards intensive IT use for school work were generally positive. Janet felt that she was good at finding and utilizing information from Google and the online library resources. She not only felt that her competency of using IT for school work was high, but also felt that using technologies for school work purposes was enjoyable. After she talked a lot about usefulness of the Compass system, I asked if any features of the popular course management system, had bothered her. She expressed a strong objection, referring to herself as a "big fan of technology:"

> Hmm? I don't know. I am big fan of technology. I can't think of anything that particularly annoys me.

The other area in which participants used IT intensively was communication in their social relationships. Most participants indicated that they were using IT for social purposes very intensively. Claire, an English major, was also engaged in a wide range of social activities on her computer. Her description about her intensive use of computers for social purposes was consistent with the popular portrait of college students who intensively utilize computers. For example, she described her use of Facebook, a popular social networking technology, in a remark like "I am always on Facebook." Her expressions of "always being on Facebook" implied that she was engaged in activities on the social networking technology very intensively.

> I spend so much time on Facebook. It's terrible. I got Facebook in my freshman year, when it was first created. It connects you to friends you already have more. I am always on Facebook...

The interview data also indicated that participants were able to use different technologies for different communication purposes in a very sophisticated way. Being able to select one technology over another to meet their specific needs of the moment was another

indicator that they were using IT proficiently in their everyday lives. For example, Emily, a Psychology major, described how she was choosing different technologies for her different purposes. She was selectively using each communication technology that would suit for her communication needs most effectively; Facebook to organize her social relationships, email to communicate with many people at once, and instant messenging systems to ask quick questions to her friends.

> Facebook is an amazing thing. I guess when we are back home, at the beginning, we kept in touch through email, like emailed each other every week or whatever, but after a while, we all got busy and we kind of drop that off. We talk on AIM every once in a while, or talk on the phone... so that's how I keep in touch with people, for people who are here, using AIM, just ask a quick question, using Facebook even, to organize parties, that's useful... Or just call people. I am pretty adept at using technologies for social purposes... It's really great being able to have an email, email bunch of people at once, other than that you will have to email people individually.

Even participants who reported some difficulties in using IT in general were also being heavily engaged in using social networking technologies. When asked if her overall competency of using information technologies was good, Kelly, a Media Studies major, had not provided an immediate response. Instead, she hesitated to say yes to the question, which signaled that she might be experiencing problems with some part of her IT use. However, when her IT uses for social purposes came to the conversation, she instantly answered yes, as she was utilizing different communication technologies intensively for her socializing purposes.

> That's a 7 [on a 7 point scale]. All I do is socializing on my computer. Hahaha...

Her big laughter in describing her intensive IT use for social purposes indicated that she felt that she was engaged in social activities using computers very intensively. Students' use of IT for social purposes was so deeply immersed in their everyday lives, that it sometimes made them quickly respond that their overall IT competency was fairly good.

4.2.2 Confidence in and Preference for Self-Learning Abilities

Another interesting finding that went with the participants' overall high perceptions of their competency in IT was their strong confidence in their self-learning abilities. Participants expressed confidence in their own abilities of acquiring new IT skills and knowledge by themselves when describing their intensive IT uses. For example, Lisa, an English major, indicated that her IT competency was good because she had the abilities to figure out the solutions by herself when she confronted problems.

> Yes, I think so [My IT competency is generally good]. I can figure things out myself, and I can operate computers, and if there is any trouble, any problems, usually I don't have to call anybody. I can figure it out.

Strong confidence in their self-learning abilities was expressed often, even when they were not able to deal with a certain technology at a given moment. They were confident that they would be able to learn about the technology without much difficulty when they would need to learn it in the future. As Abby stated:

> Sometimes the [technical] projects were hard, but it was nothing that wasn't accomplishable... I think I have enough base knowledge to accomplish anything that I would want to accomplish, if I want to learn more I could figure it out on my own without struggling too much.

Many other students also expressed confidence in their problem solving ability regarding their IT use. Dave, a Political Science major, commented:

> I don't expect any difficulty in learning technical things. I pretty much taught myself, how to use Photoshop, within the last two weeks, that is ridiculous because there are so many options, I mean, as far as formulas and stuff go, something like for example Excel, it's gonna take a little time to get used to it. But after a while I think it'll be to the point, I'll be able to do it so well once they found a better program, I'll struggle with it because I will be so used to the other one,...

Participants' confidence in their self-learning abilities went with the development of technical applications that have become easy to learn, which is often reported in recent

studies on IT development (e.g., Beringer, et al., 2008). It seemed that the development of technologies that have become more self-explanatory and easier to learn contributed to students' confidence in their self-learning ability. When asked about their IT use for their school work, many students talked about their use of recently developed course management systems, such as WebCT, Compass, and Moodle. They reported that there was nothing too difficult to learn to utilize these class supporting technologies.

Another such example reported in this study was their experience of learning how to use an iPod. Participants said that an iPod was so easy to use and self-explanatory, that they learned it just by trial and error, pressing a few buttons on it and seeing what happened. It was so easy that participants sometimes even questioned if there was any technology in it. Jenna's comment about iPod, that she was not sure if that was technology or not, was a good example.

> I basically use my laptop out of school, and I use iPod, I don't know if that's technology or not. I just tinkered around with it myself, and it was pretty self-explanatory. I did not read instructions or anything basically.

Similarly, Abby, a Journalism major, came to realize that her use of iPod was a relevant topic in discussing her IT competency after describing all of her other IT uses, only when it was close to the end of her interview session.

> Oh god. Did I forget to say that [iPod] before? I have had an iPod for three years. I just pressed buttons on it [iPod] and figured it out. I didn't look up a manual, hahaha... When I wanted to learn how to upload music, I looked in the manual, but it was really easy, you just plugged it in and it just goes...

Accompanying the strong confidence in their self-learning abilities was participants' preference for learning information technologies by themselves, rather than asking for guidance from other people. Regardless of their motivation to learn IT, most interviewees indicated that they would try as much as they could to learn IT by themselves before looking for someone else for help. As Taylor, a sophomore in Finance expressed:

> I figure it out by myself until I get totally lost. Then I'll find some help.

Most participants said that they would try by themselves before asking other people or looking for a formal training opportunity. They would ask experienced people or search on the Internet only when they still had problems even after having enough self-trial. As Eric, an MIS major, stated:

> I usually teach myself. Basically everything I've done... We've done group work like in my Graphics course here. Most of the learning was still by myself. I like being able to take my own time to do it and spend as much time as I need and then if I need help then I will ask somebody.

Abby, a Journalism major, also clearly stated the steps that she would take when she solves an IT related problem. She would try to solve a problem at hand by herself first. Only when that did not work, she would find other people's help.

> I would prefer to look up a manual first to see if I can figure that out myself it is something really simple that I'm missing. If not, I would prefer to ask a person.

One reason for this preference for the self-guided learning can be found from the fact that their use of IT is embedded in a variety of different activities. Therefore, when students need some help, they would look for IT expertise that is associated with some domain knowledge. As IT is being used for a wide range of purposes and the use is becoming more area-specific, a knowledgeable person who understands the specific problem area may not be easy to locate nearby. Thus, they would try it by themselves, rather than spending time to find somebody else who might have that specific knowledge. Jack, an Advertising major, talked about his learning experience of some Apple software applications. He reported that he had to learn them by himself because not many people around him were experienced with those Apple software applications.

> That's a lot of trial and error, especially with the Apple ones, because there's not a lot of people right now that are familiar with a lot of Apple applications.

Besides, many participants of this study stated that they found the learning processes of tinkering around with computers to figure out new things was enjoyable and fun in itself. They believed that by learning by themselves, their learning would be more effective, if

not more efficient. Matt, a Computer Engineering major, described the fun he had experienced when he tried to learn new technologies by himself.

> I talk to people out there to get the basic knowledge of what I want, and then do some stuff on my own, do some trial and error, can I do this, can I do that? Yeah, okay, I want to do this, let me try this, if I can't do it this way, all right, I don't know how to do this. Then go back, say yes, I am trying to do this. What's the best way to do this? I am doing it this way. Is there a better way of doing it? So I love figuring things out on my own, but I also know that some of the best ways to figure stuff out is talking to people in a group.

This meta-cognition about the processes involved in learning technical skills contributed to their confidence in their self-learning abilities. Participants were aware that they were not able to understand technical skills if they did not try them by themselves even after having received good instructions. They knew that they would be able to fully understand the technical topics only after they tried different features by themselves. Students had the notion that they could consolidate what they had learned into their own knowledge only through a process of making trial and error. This understanding made them prefer learning by themselves. Jenna, an English major, tried to learn technical skills by herself because she knew that she needed to practice repeatedly to get used to those skills.

> I think I learned when the teachers talked about it, it's helpful for an introduction. But what really helps to do it myself would be experience. Otherwise it's really hard to learn. My classmates help me out, but it's really more of me, just like doing it. Otherwise, it's really hard to grasp a computer program they put on a board and tell you the steps that you can't pick it up unless you actually do it.

Another factor that influenced participants' strong preference for learning by themselves was their positive past experiences of working on IT problems. An example was students' experience in which they found solutions easily by looking up Internet resources, without needing to bother other people. Preference of learning by themselves using Internet resources was reflected in an expression like, "Google is my best friend," which many participants frequently used. For them, looking up the Internet using search engines like

Google was the first step they would typically take. Search engines provide students with an easy way to locate product manuals and related documentation.

Joining internet communities on some specific technological topics was mentioned as another easy way of learning by themselves with the help of resources on the Internet. Participants reported that they frequently looked at blogs, web forums, and discussion groups where people collectively discuss IT-related problem solving. For example, they type in a problem that they have in a search box, and then they often get a message board where other people ask questions and post answers related to the problem. These processes are easy and effective, probably easier than looking for a knowledgeable person around them and asking questions of that person. As Larry stated:

> I usually look on the internet actually. I just type in whatever problem I am having, maybe I will get a message board about how to use this stuff. I think it's the easiest way to get information. Because sometimes I am working on something that other people around here might not have experience with, or there are very few people who might have experience with, so I guess that's where I usually get my information from.

The strong preference for self-guided learning implies that students believe that they have the ability to learn many IT skills and knowledge by themselves. Their meta-cognition on what steps they will need to take to acquire new IT knowledge and skills contributed to their belief that they can learn the technologies by themselves. Preference for, and confidence in self-guided learning were potential reasons that participants felt their IT competency was generally good.

4.2.3 Early Experience with IT

Another contributing factor observed in the interviews was students' early experience with computers in their childhood. Previous sociological studies about people's computer use have explored the influence of early exposure to computers on peoples' later computer use (e.g., Goodson and Mangan, 1996). Those studies often argue that a person's early exposure to computers makes a significant difference in his or her later comfort level of utilizing computer technologies. That logic has been frequently used to

provide school computers to classrooms and provide instructions on computers to young people (Nussbaum, 1998).

Most interviewees in this study however, except for two students, said that they had a computer at home since they were young. It was not surprising considering that most of the participants were around 20 years old and had grown up with computers in the period of accelerated growth of the Internet in the 1990s. Most of them reported that their parents got a home computer for their kids. Therefore, most participants had been engaged in some computer activities since they were young. Playing computer games was the most popular activity. Many participants started to use computers for their school work, for example, by typing up their papers for classes. Those two interviewees who did not have a home computer reported that they learned computers later, mostly from their friends in college. Even though they had not experienced computers earlier, they did not have many problems in catching up on the computer use skills later after they came to college. For example, Claire, an English major who was one of the most deeply engaged in social activities on computers in this study, did not have a home computer before coming to college. However, she reported that she easily acquired computer skills and knowledge at school and did not have much difficulty in catching up to her friends. Therefore, it is hard to say that early experience with computers was a critical factor that made a difference in the competency perception of this group of college students.

It was also found that gender did not make a big difference in their IT competency perceptions, unlike the general findings from previous studies on the relationship between gender and IT. Gender has been taken as one major indicator that explains differences in people's use of computers (e.g., Hargittai, 2003; Ching, Basham, and Jang, 2005). However, descriptions of their uses of IT were not different between male and female participants in these interviews. Both male and female students in this study said that they had used computers since they were young, playing games and typing up homework. In college, both male and female students intensively use computers for school work, communication, and some entertainment purposes. It seemed that gender was not a critical variable that differentiates their levels of IT use. This finding is consistent with recent research results that the role of gender in computer usage is generally diminishing (e.g., Knight and Pearson, 2005).

If gender made any difference in this study, it was not in their everyday use of IT, but in their choice of technical careers. While earlier exposure did not make a difference in their later computer uses in everyday life, gender was still strongly associated with students' choice of technological majors in college and pursuit of technical careers for the future. For boys, great interest in playing games often naturally developed into a desire to learn programming language to make games by themselves. Zachary was a classical case in which parents' intensive use of computers introduced boys to computing and later led them to pursue a career in the programming field. Zachary had a lot of exposure to computers when young, as his dad was an accountant who utilized computers heavily all the time, even at home. Zachary's early encounter with computers started this way and triggered him to learn programming to make games by himself, which later led him to choose Computer Science as his college major without hesitation. For him, the experience of playing games naturally developed into programming. As he said, programming was often considered to be "the next step."

However, for girls, early experiences with computers are less likely to develop into later career choice in technology or science. Emily, a female Psychology major, was a contrast to Zachary's case. The way Emily was introduced to computers was very similar to Zachary's. Her father was a project manager at a big IT company. Like Zachary's father, Emily's father always worked with a computer, and sometimes brought work home. Emily had watched him working on a computer since she was young. Her father always brought a good computer home since she was 4 years old. On her home computer, she frequently played games as Zachary did. However, unlike Zachary, this early exposure to computers did not lead her to pursue a technical career, although she expressed strong confidence in her IT competency in general, possibly due to this early experience.

Examination of their early exposure to computers and their early use of computers revealed that the participants in this study are the generation that had a lot of early exposure to computers since youth. This rich early experience contributed to their general feeling that their IT competency was okay in terms of everyday use, regardless of gender. Gender may have influenced students' choice of technical careers, but did not have as much influence on their overall competency feeling in terms of their IT use.

4.2.4 High Self Competency as a Generation

The interview data revealed that students' self-perceived IT competency is a very generational phenomenon. Participants considered themselves as proficient in utilizing IT as a generation that had grown up with computers, and were better than the older generation people in general, regardless of their individual self-competency rating. Even those participants who rated their IT competency very low, believed that their IT competency was relatively high in comparison with older people. For example, Brad, an Economics major, was one of the few participants who rated his IT competency very low. According to his own expression, his IT competency was "in the lower half of his peers," but at the same time, he said that his competency was good if he compared it to that of the old generation. Participants considered this base level competency as a generational effect of having grown up with computers, as computers had been always a part of their lives. Besides, they took this ability to work fluently with computers as their qualities that would differentiate them from older people as a group. This feeling was consistent with the finding from the previous section that most participants had early home computers and had plenty of early exposure to computers.

While most participants felt that they were better than old generation people in general, peers' competency of dealing with IT had significant influence in rating their own IT competency. Brad mentioned above determined that his IT competency was low in comparison with his peer groups. Some participants even reacted sensitively to their peers' high IT competency. For example, Kate, an English major, stated that she always wanted to know more about information technologies when she had instances in which she did not know the things that many of her peer students did know. She expressed her discomfort about the finding. This comparison strongly motivated her to learn about technologies.

> For example, I recently discovered YouTube. I didn't know about YouTube until there's all the publicity about it. Sometimes I am totally oblivious to things that everybody else knows about. Various websites that everybody talks about... and I'm like, "What's that?"

While peers' IT competency was significant in determining their self-perceived IT competency, participants' attitudes towards younger people's computer use were a contrast, as they did not take younger people's competent use seriously in any way. Participants were aware that their younger siblings were very good at dealing with computers, sometimes even better than themselves. Emily felt this way when she realized how competent her 13 year old sister was in utilizing various IT applications. She ascribed it to the fact that she did not grow up with computers as her younger sister did. Her remark supported the argument that students' self-perceived IT competency is generational from another direction. In spite that Emily actually had plenty of exposure to computers when she was young, she felt that her younger sister had even more intensive computer experience, for the reason that her younger sister was utilizing more up-to-date technologies such as instant messaging services which were not that popular when she was young.

> I think it's just I didn't use it while I am growing up as much, as my younger sister, she is on AIM all the time, that's her main form of communication, but when I was her age, I just called people on the phone, I still tend to call people, frustrated with typing.

As was shown above, while participants acknowledged that younger people were more active users than themselves, their attitudes towards younger people's competent IT use was "indifference." While Emily admitted that her younger sister was using IT very competently, she did not care about what her younger sister did with a computer, and was not interested in knowing about the details of her sister's use. She commented that her younger sister's computer use was very intensive, but also the use was mostly for entertainment, with "nothing serious, but just for fun."

> It's actually scary how good she [my sister] is... She is 13 years old, and really enjoys playing flash games online and going to YouTube to watch funny videos, and I thought it was crazy because she discovered the YouTube and started watching it at home at the same time I did hear [about it].

Overall, the participants felt that they had good IT competency because of the fact that they were the generation that had grown up with computers. Even though they sometimes

felt that they were not as competent as their peers, they felt that they were good as a generation, especially in comparison with the old generation people. Participants' attitude toward their younger siblings' IT use was characterized by indifference. They thought that younger people might be dealing with IT more competently than they did, but their younger siblings' IT use was not a significant factor for them to determine their own IT competency. From their different attitudes toward IT use of older people, peers, and younger people, it can be inferred that students' self-perceived IT competency is very generational.

4.3. Gaps in Their Self-Perceived IT Competency: Technical Skills and Knowledge

4.3.1 Hesitation and Inconsistent Answers

While many participants responded that their IT competency was okay in some way or another, most of them who indicated so also pointed out that there were some gaps in their skills and knowledge of IT. In this section, the areas in which the participants felt gaps in their IT competency were examined. First, those gaps were examined by looking into their hesitation in answering yes to the question that asked their perceived IT competency. Next, the gaps were examined from their inconsistent remarks within their interviews, as some students answered that their IT competency was sufficiently good in one part of their interviews, but mentioned something different about their IT competency in other parts. In general, the analysis found that the deficiency areas are mostly technical skills and knowledge.

One indicator that showed students' gap in their IT competency was their hesitation in determining their own IT competency. To the interview question "do you feel that you are generally good at dealing with information technologies?", some participants showed a few seconds of hesitation, not like many other participants introduced at the beginning of this chapter, who provided a positive answer immediately. Looking into what caused the hesitation may reveal which areas of IT that they felt uncomfortable with. Lucy and Kelly were those participants who did not immediately say that their IT competency was good.

A few seconds of silence in their answers indicated that they were exploring different aspects of their IT use before talking about their competency in dealing with IT.

Lucy responded to this question with hesitation, saying that "Uhm... sort of, but kind of not." Lucy, a History major, actually was a quite active user of information technologies. She had started to use her home computer since she was young and used computers intensively all the way up to her college years. However, when asked to rate her own IT competency, Lucy brought the difficulties she experienced in IT classes into her judgment. She commented that the new things that she had learned in IT classes, such as XML and databases, were like a foreign language to her, indicating that she had difficulties with the technical subjects. Overall, she said that her IT competency was currently okay as a college student, but expressed discomfort whenever highly technical activities came to the conversation.

Kelly, a Media Studies major, was another student who expressed similar hesitation to this question. She did not answer that her IT competency was good, saying that "Umm... it's hard to answer..." However, she indicated that she was pretty good at utilizing IT in other parts of her interview. She was accustomed to using computers since young. She indicated that she had used computers for typing since she was in the 7th grade. Her rating of her IT competency illustrated this conflicting attitude in more detail. In an earlier part of the interview, she had indicated that her overall competency with IT would be medium, which may be "4 out of 7." However, when asked about her social uses, she said without hesitation that she was definitely good and did not have many problems. This attitude is reflected in her self-rating about her IT competency. As a senior, Kelly wanted to be a librarian after finishing her education. She predicted that having enough technical grasp would be her biggest challenge in the area that she was pursuing. This consideration about the technical competency requirements of her future job made her hesitate to answer that her overall IT competency was okay.

As examined above, these two students commonly pointed out programming as their deficiency area where they lacked sufficient knowledge. Also, their hesitation in answering positively to the question did not indicate that they were not good at using information technologies. Rather, their hesitation indicated that these participants were

thinking seriously about different aspects of their IT use. They even had more insights about their own IT competency than other people who instantly responded that their IT competency was okay.

Another indicator that told about students' perceived gap in their IT competency was the inconsistent answers that some participants provided. At the beginning of this chapter, it was reported that many participants immediately answered yes to the question that directly asked about their self-perceived IT competency. However, many of them who said an instant "yes" also reported something different about their IT competency in the later parts of their interviews. While these interviewees indicated that they used IT all the time in their everyday life, they often made a statement like "I'm not good at computers" in other parts of the interview. Considering their intensive everyday IT uses, it sounded contradictory, in that they broadly described themselves as not being technically savvy. Some students even repeated that they were not good at computers throughout the interview sessions, in spite of their initial positive answers to the question that asked about their overall IT competency.

One such interviewee was Kate. She initially had indicated that her overall IT competency was okay, but expressed discomfort about dealing with IT throughout her interview. Kate had indicated that her IT competency was okay after some hesitation, saying "Umm.... Generally good, yes." However, Kate emphasized throughout the whole interview session that she was not very familiar with any technologies. For example, although she was pursuing the IT minor, the "technology" part in the title of the IT minor always scared her away. When she had to choose IT classes to take, she always chose courses that sounded less technical. For example, she chose "Computing in Humanities" over "Science and Computing" when there were those two alternative choices for her IT electives. The reason was that she felt the science part "scary," and considered the humanities part might be "safer" for her to choose. She reported that generally the technical aspects of the IT classes that she had taken very hard and overwhelming. About the technical requirements, she felt many times "I don't get it," and repeatedly said that "It's just hard, it's hard for me." She felt that she lacked technical skills not only in the class contexts, but also in her everyday life. She indicated that she had many computer issues, although she was very active in using technologies for her school work and for her social purposes.

> The other day, I was scanning things into my computer for class, and I couldn't figure out where they were saved. It took me a while to read the directions online. I basically know how it works, but when things go wrong, I can't figure it out usually.

As was the case of students who showed hesitation, students' negative answers about their overall IT competency did not mean that they were absolutely poor at dealing with information technologies. Rather, it was just a part of their inconsistent feeling about their IT competency. When they were talking about their usage of technologies in everyday life, they felt that they were competent. When they were talking about creating some artifacts on a computer, like creating a web page, they felt that they had insufficient knowledge. Often, the different feelings in the different situations caused the inconsistency in their self-perceptions of their own IT competency.

4.3.2 Technical Areas of Programming Skills and Hardware Knowledge

From the participants who showed hesitation and those who provided inconsistent answers, it was observed that the areas in which many students felt unsure was related to programming skills and hardware knowledge. Except for technological majors, participants in general pointed out that the areas where they were not very competent were those technical areas. It seemed that the areas that require some level of technical expertise, such as programming skills and computer hardware knowledge, made many participants feel uncomfortable about their IT competency.

One of the technical skills that participants mentioned was programming skill. This was evident in Kelly, a Media Studies major's comment. She indicated that she felt that programming skills would be essential for the library field that she was planning to go into after graduation. She indicated that she could not rate her IT competency because she did not know how to do programming, in spite of the fact that she was very good at using information technologies. When asked the question how she felt about her own IT competency, she said after a long silence that:

> It's [rating my overall IT competency] hard to answer because like I said I feel really incompetent as far as being a programmer.

Participants did not care about the "programming" that CS people would do. Many students showed an "it's none of my business" attitude. However, when some part of the programming area, such as skills to build a webpage, became relevant to what they did or planned to do, they felt that they lacked the "programming" knowledge. Abby, a Journalism major, also showed some hesitation in saying that she was generally good at using information technologies. She indicated that her technical competency was good enough to handle her daily tasks. She knew how to use a photo editing software to submit her photos and how to use a word processor to type up her stories for her work. In spite of her belief that she had a fairly good understanding of technology enough to work productively in her own area, she reported that she did not have enough technical competence, such as making a web page by herself.

> I think on the average I probably know more than average journalist who does just writing. I know more about online journalism. But could I just sit down and make a webpage or something like that, no. I think I would need more instruction...

Another technical area where the participants found they were not good at and would find other's help for was hardware knowledge. They indicated that they would find other people's help when they have technical problems that they cannot fix by themselves. For example, Jenna indicated that she did not have much hardware knowledge and wished she could fix the hardware problems without asking help from IT people.

> When I have a problem with computers, I don't know how to fix it. I wish that I knew more about computers, just like the technical, actual hardware of computers, if I have a problem. When I had a virus, or something is not working, I'd like to know how to fix it, instead of calling IT people.

In turn, having the technical skills of programming and understanding of hardware issues were the ground upon which participants feel competent in dealing with IT. Some participants had a higher level of technical skills and knowledge than others. Their technical competency justified their feelings that they had overall high abilities of utilizing IT. Emily, a Psychology major, said that she was better than her peers on the ground that she had higher technical skills than them.

> I think I have more IT skills than most people who aren't engineers. Obviously engineers and computer science people have more information technology skills than I would, but general humanities major, I feel I am much more prepared. That's definitely a point that I would use to sell myself... "I have experience in webpage design, and I understand about technology issues that we face today. I am good at finding information."

Dave also rated his IT competency high on the ground that he had higher technical competency than his peers. He described his IT support role among his housemates as evidence that his IT competency was good.

> I would say so [I think I am generally good at using IT]. I think like that because... I know how to run stereos... okay, let me put it in this way. I am in a house with 8 people, including myself, others are roommates in the house, I am pretty much the technical guy. Whatever one of my roommates, she wants to connect to the internet, she will call me, I'll look at her router settings and things like that. So I would say, yeah, I have a pretty good grasp what it's like, as far as technology goes...

Technological majors generally felt that their IT competency was good because they had received intensive training in various technical topics. The first section of this chapter described the ways that technological majors responded to the question that asked their self-perceived IT competency. The technological majors' responses about their IT competency were often accompanied with big laughter. This laughter was due to the fact that people who work in technical areas acquire a rich understanding of technologies not only through formal instructions on technologies, but also through lots of practice in those fields (Twidale and Nichols, 2006). A large part of their technical expertise is obtained implicitly through their various experiences of dealing with technologies over time. The way in which technological majors think about their self-competency of using technologies was exemplified in Ricky's statement.

> If you know how to build it, if you know how to take the parts and put them together, you automatically know how to use the completed components, or the completed technology.

From the above findings, it can be inferred that the lack of technical skills and knowledge of IT makes students feel that their IT competency is not high enough. In turn, having those technical knowledge and skills works as a ground upon which students feel competent. In spite that people do not have to deal with complicated technologies when dealing with many user-oriented technologies, knowledge of technical subjects, programming skills and hardware knowledge, was still a significant factor that determined if they were competent or not competent in dealing with IT.

4.4. Prompting Factors to Fill the Gap in Students' Technical Knowledge and Skills

Findings from the above sections indicate that students' perceptions of their IT competency were not a stable feeling. Their answers were different depending on what kind of technologies they were talking about, and what situations they had in mind when judging their adeptness.

Because of their intensive IT use in everyday life, students often do not explicitly question their own IT competencies. The instant "yes," which was frequently observed in this study, implies that students do not seriously question their IT competency in their everyday life. Although many participants admitted that they lacked technical expertise, recognition of the gap did not occur unless some impending needs prompted them to realize their knowledge gap. Participants tried to take some actions to fill the gap when they found the technical knowledge very relevant to resolve their concerns.

4.4.1 Comparison with Peers

One significant prompting factor that made participants feel less competent in dealing with IT was comparison with their peers. When participants saw a very competent classmate in the same class had a lot of knowledge in the class subjects that they had not had, or sometimes were not even aware of, they felt a need to enhance their knowledge and skills. For example, when Lucy saw a classmate who talked about many different aspects of computing knowledge that he had, she had an envious feeling about him and felt that she needed to learn more about computers. She especially wanted to learn how to build interactive web pages.

> Especially, even in this class, there is one kid who is really good at computers, and will be talking about technical stuff.. he'll just raise his hand and rattle off.. "I know blar blar blar"... I was like "What is he talking about?" and also like I wish I could do that. You know, there is a lot of things I know I don't know yet, but I wish I could do that. Like SQL, stuff like that, I know basically how to do... I can do it, but not very complex stuff and I am not proficient. Maybe another thing I wish I was better is troubleshooting, if something goes wrong on my computer, I still sort of like, what.... I call my dad. You know I can't really do anything per se about it. So I wish I was better at that kind of stuff..... It gives me a sense of, like I really still have a lot more left to learn.

Significance of peers' competency was already reported in the previous section. Section 4.2.4 pointed out that the perceptions of IT competency are a generational phenomenon, which is consistent with this finding.

4.4.2 Computing Classes

Interestingly, a context in which participants reported some gaps in their technical knowledge was when they considered taking computing related classes. For one, comparisons with peers evoked a strong feeling especially in class contexts. For another, taking a college class in technology was one way to verify their own technical competency for them. Lisa, an English major, had plenty of exposure to computers since she was young. She played games, used email, wrote up papers, and searched the Internet. She said that she does not have any problem in operating computers. She added that she could figure things out by herself when problems occur. However, she rated her overall IT competency just above average, and attributed that feeling to the fact that she had not had any sort of training or education in IT.

> I can figure things out by myself. But I don't have any sort of training or education in the real technical aspects. It's just you know the bare bones of things, but actually operating computers I can handle.

Claire, an English major, also implied that class contexts were where she had some gap in her knowledge. Earlier she said quite confidently that her IT competency was generally good, but her comments that she added to that statement implied that she did not feel that

way in her classes. About the question that asked about her overall competency, she answered:

> Yes [I feel that I am generally good]. Hahaha... Don't ask [name of an instructor of an IT class] that question. Not as far as the kinds of things that we're learning in our networking class. But, the basic everyday use of computers I am okay with it.

Kelly talked about her concern that she had when considering the IT minor. Her concern was that she was not very savvy in dealing with IT, especially in that she did not have enough computer skills to program. Students considered that computing-related classes were mostly about programming.

> One of the things that really concern me going into it [an IT class] is that I don't have very much programming experience, you know, computers... I can just deal with general Microsoft Office, that's about it. So I was really worried about it, and especially with the group project.

The participants assumed that classes that teach computer technologies would require a high level of technical expertise. Students automatically associated the curriculum of any computing classes with that of traditional computing disciplines, which is highly technical and abstract. Rachel's IT usage in everyday life was as intensive as other participants. She was heavily utilizing popular social networking technologies, instant messaging services, and even fee-based textbook subscribing services. As she felt those recent technologies were easy and self-explanatory, did not have much difficulty in figuring things out by herself. However, when the conversation came to the IT program itself, she commented that learning hands-on technical skills in IT classes was something that scared her away. The reason was that she generally did not enjoy learning any new technologies, because they were "frustrating" to her. Her remarks also implied that students expect technical activities in classes, and the technical skills in a class context rather than in everyday IT use context make students feel uncomfortable about their IT competency.

This section showed that participants felt some gap in their IT competency when considering their IT competency in a class context. This feeling was closely related to the

finding in the previous section that students feel their knowledge gap in terms of technical issues like programming skills and hardware knowledge.

4.4.3 A Transition from School to the "Real World"

Another obvious factor that stimulated students to learn more about IT was impending graduation. If the career fields that they pursue utilize technologies intensively, they felt pressured to become more knowledgeable about technical skills, as their graduation was approaching. Here are the examples. Kelly was pressured by a need to learn programming to seek her future career in the Library field.

> I think, again, for me, in the field I am preparing for [librarianship], I really feel like having more programming would be essential...A need to be able to make a webpage.

Brad felt a strong need to learn Excel. As graduation was approaching, Brad, as a senior, remembered what his father, who was an accountant, had criticized about an intern that he had, who did not have enough Excel skills. His father's comment alerted him that he might need some level of expertise in Excel if he wanted to go into any related fields. His desire to be more proficient in Excel was more relevant to his post graduate life, rather than his current life in college.

> He [My father] said his intern came in but she had no idea what to do with Excel. He was like "How doesn't an accounting major know Excel?" So he sent her for a week for a course to get that all figured out. I don't want that happen to me. I want to make a good impression when I go in for my first day when they give me a relatively straightforward task on Excel. I just want to do it, no questions asked.

Janet's desire to learn desktop publishing arose in the same context. Janet expressed her urgent needs of learning desktop publishing programs, because she had realized that most major magazines and newspapers use those desktop publishing programs to publish their news. When she became a senior, she found that the publishing job is very competitive. She originally chose English as her major having a future career in publishing in mind. When it came to time to start her job search, she found that the publishing field is very competitive and even getting a foot into the door is hard in that field. The hard thing is

that this field has only a few job openings and requires a lot of work experiences even for fresh college graduates who are seeking an entry-level position.

> Publishing jobs are very competitive. I don't know why... I wish I knew. It seems like, a lot of people want to do it, and there aren't that many openings. With business, there are openings all over the place, but in publishing there's only a certain amount of publications, and there's only a certain amount of jobs at those publications.

When confronting the transition, participants recognized that there must be some other skills to acquire in addition to their academic training, but were not very confident about what skills would be necessary for other purposes beyond college education. Need for learning IT, if any, was associated with their uncertainty about the future that they had not experienced yet. Lucy stated that her IT competency would probably be okay in her later life too, but was not really sure how good she would be, as she felt that she was not ready for the transition to the professional world yet. It could be seen that Lucy's nervous feeling about her low IT competency was more closely related to her future use than to her current use.

> I don't know. It probably depends on what kind of job it was. But at this point, I would probably be okay, but not... I definitely would not be an expert level at any sense. I am not really sure how good I would be. I don't think I am ready for the professional world yet.

Students, especially students in their senior years, generally think that their life beyond their college education would require them to learn different, maybe a higher level of IT skills and knowledge, even though they think that their current IT competency is okay for their current lives as college students.

4.4.4 Indifference to a Knowledge Gap in IT

The above findings showed that realization of students' knowledge gap occurs only when the knowledge gap is meaningful and significant to students themselves. In contrast, if the gap is not something very significant to them, they do not care about the gap even if they are aware of it. Their indifference to fill their knowledge gap in technical topics

provides additional evidence that students recognize their knowledge gap only when some immediate needs prompt them to re-examine their IT competency.

While many students reported that they lacked technical knowledge and skills, they did not feel that the technical gap was something that they needed to fill when they felt the gap was distant from their immediate concerns. For example, Kelly had indicated she would just call IT people to have her hardware problems fixed instead of trying to fix them by herself. She said, "when a computer breaks down, I take it to IT people or call my brother." She did not look bothered by the fact that she did not have the technical skill to fix a broken computer. She would just bring the broken computer to other people and have it fixed. Her indifferent attitude about the problem of fixing hardware problems was a sharp contrast to her nervous feeling about not being able to program that was described in the previous section.

Another occasion in which such indifference to their technical knowledge gap was expressed was when they were assigned technical class activities of which they did not realize the significance. Abby talked about a class assignment in which she had to make IBM punch cards in an IT class. This class activity was designed to help students understand the historical issues of computing. However, she did not understand the significance of understanding the old form of computing, which was the major reason that she complained about this technical class activity. She added that she would rather learn "what it was," and "why students needed to learn this," before they were jumped into the activity and were forced to make one. Her comment shows that it is important for students to understand the meaning of the technical activity if it is something that they need to learn.

> Yeah, the lab... It felt like we're jumped in, like the very first lab that we had, we had to make a punch card, like an IBM punch card. I've never even heard of this. I felt that I was jumped into some technical knowledge too fast without.... I think there wasn't enough time to explain it. I didn't even know what the punch cards were. So I have had a class like this... but I thought it is interesting once I learned, instead of saying we're going to make one, I would rather learn what is it, and why do we need to learn this before we just jump in and make one.

Abby compared that class with another IT class that helped students' understanding with an analogy that students could easily understand. She felt that the class explained its technical activities step-by-step so that students who did not have much technical knowledge could get the understanding without much difficulty, instead of assuming that the students already had some level of knowledge in the subject matter and jumping into the topic directly. When technical topics were explained this way, she gladly complied with the class requirements to conduct technical activities.

> He [an instructor of another technical class] did a lot of things that made them really easy for everyone to understand, coming from non-technological background. He would draw things on the board and we have pieces of string that we all held to show how the Internet worked which I thought that was very interesting, so amazing, how you can just click buttons and all this information appears... so it was a lot of fun. It was a lot interactive. He didn't jump in with "Oh today we all have to make an IBM punch card."

Similarly, Dave vaguely felt that databases would be something that he would need to learn for the future but not sure about the necessity of learning about them at that point, as he had not seen yet how the knowledge could be applicable in his later life.

> I will need to know database use or something like that, but I don't think it's something that I can learn right now, because I have no idea what they use, or where I am gonna be... I don't know what kind of programs that I am gonna use... so... I mean, that's something that I definitely need to know, whenever I start working at these places.

All the above comments showed that students do not care of their knowledge gap, even if they know about its existence, if the knowledge gap does not have any immediate significance for them. This indifference about their lack of purely technical knowledge was a sharp contrast to the situations in which the knowledge gap had an immediate value for them.

4.5. Summary

Most participants in this study felt that they were generally competent in dealing with information technologies. These perceptions were based on their intensive use of IT in everyday life, for school work and for social purposes, and their continued experience with computers since youth. It was also manifested by their preference for and confidence in self-learning. Students' IT competency perceptions were very generational. Regardless of their individual perceptions of their IT competency, they felt that they are generally better at utilizing various information technologies than older people, and did not care about younger people's competent use. Most participants determined their IT competency in comparison with the competency of their peers.

In many cases, their level of technical expertise determined their overall self-perceived IT competency. Regardless of their intensive use and high self-rating of their IT competency, participants, especially those who were not technological majors, thought that they did not have high enough IT competency because they lacked technical expertise such as programming skills and hardware knowledge.

Students' IT competency perceptions were not a stable feeling. Some students felt discomfort about their lack of technical knowledge, while other students did not care and even were not aware of the deficiency. In general, they did not explicitly question if they were competent enough in dealing with IT in their everyday life. Recognition of the gap occurs only when some impending needs prompt them to realize their knowledge gap and motivate to them fill it. One significant factor in determining their IT competency was comparison with their peers. Another significant context was computer-related classes. Impending graduation also changed their IT competency perceptions. When graduation was approaching and the career fields that they hoped to pursue required technical competency, they recognized a gap in their IT skills and knowledge, and tried to fill the gap. In general, participants recognized the gap as something to fill only when they found the knowledge very relevant to resolve their immediate concerns. The chapters that follow will examine how their self competency perceptions, along with other factors, develop into their motivation to seek formal IT education in college.

5. COLLEGE STUDENTS' NEEDS FOR FORMAL EDUCATION IN INFORMATION TECHNOLOGIES

Previous studies have reported that people often acquire IT skills and knowledge more through informal paths than through formal training opportunities (e.g., Freeman and Aspray, 1999; Hawkins and Oblinger, 2006; Spitler, 2005; Twidale, 2005). In Chapter 4, it was reported that many participants in this study also learned IT informally through personal exploration or interactions with peers. Then, the question is, what factors would draw students to seek a formal IT education opportunity, instead of learning informally as they indicated they usually did?

To explore the reasons, I first examine students' changing understanding of information technologies. The significance of IT that they have found may be related to the reasons that they would seek a formal IT education opportunity. Then I explore the effectiveness of their informal learning embedded in everyday contexts. The reasons that they would seek formal education in IT may be inferred from what they get and do not get from informal learning which is known as the most frequent way of learning computers. The effectiveness of short computer training sessions offered through the campus IT support unit in responding to students' need for computing education is examined as well, to explore the possible reasons that students seek an IT education opportunity as a formal education track.

5.1. No Longer Just a Gaming or Typing Tool

Interview data showed that college years are a critical period when students' use of computers greatly diversifies. Participants indicated that they realized various potential applications of computers though their extended activities with computers for their school work, for communication, and for their other tasks.

In Chapter 4, it was reported that most participants of this study had had early experience with computers since they were children. Most participants indicated that their primary use of their early home computers was playing games and typing up their homework.

Many students stated that their parents brought a computer home for their kids as an educational tool, with a hope that their children get familiarized with computers from a young age. However, for them as kids, many times the early home computer was just a novelty to do fun things rather than being an educational tool. As their usage was not aimed at attaining serious goals, their early use was often limited to fun activities such as playing games, and some other recreational uses. As Chris stated:

> It [an early home computer] was not really a source of information for me. It was more of a novelty. Making and playing games is the only thing that I really cared about.

As those kids came to college, their computer activities expanded beyond kids' recreational uses. They started to see the different consequences of applying computers to their various activities. It was partly due to their enlarged autonomy of using computers given to them by the time of entering college. Many participants reported that it was the first time in their lives that they had gotten their own computers. Before college, they often had home computers shared with other family members. It seemed that having their own computers enlarged their autonomy of experimenting with diverse activities, and greatly contributed to their expanded use of computers for various purposes. As their range of computer experiences grew and expanded, their focus of using computers gradually shifted from having fun or getting their homework done to the possible advantages that utilizing computers would bring them.

For example, Rachel, an Accounting major, said that she started to see the benefits of using IT and the efficiency with which things could be accomplished with computers in her classes. When she was enrolled in one class that heavily utilized Microsoft Excel, she started to realize the benefits of using that software application in accounting. At that time, Excel started to become relevant to her life and triggered her interests of acquiring more knowledge of Excel.

> Um… [I see the benefits from my school] Just using it [Excel] for school work, because I had never used Excel before, until I came to college and I took my Computer Science course, and now in Finance and Economics, I find Excel so

> useful because I use it with everything. I use all the shortcuts and all the different buttons, now I know how to use them, just make my school work so much easier.

In addition to Excel, Rachel became used to many other class technologies for her different classes. She indicated that she found many advantages that the technologies could bring to her. As a result, she started to enjoy using technologies for school work and actively seek ways to utilize computers.

> I like it [using class technologies] a lot, because it cuts down paperwork, when we have to write it, sometimes we might lose it or misplace it, and this way, I can work on it anywhere, like if I have time between classes, I can go to a library or a computer lab, and work on my homework, and when I need my book, like my Finance one the book is online, and I have a paper copy of the book, but I don't need to carry it around, because I can just go to a computer and read it... So I like it a lot.

Rachel felt this way in spite of her self-perception that she was not very good at dealing with computers. Earlier in the interview, she had indicated that computers were not very interesting to her, nor were easy to learn, saying that "I really don't like learning new technologies because I think they are really frustrating, but I really do see the benefits of doing it." Her remarks implied that college is a place where students start to learn various usages of computers and realize the advantages.

Evidence that students realize the significance of computers while going through college, and that this in turn made them interested in learning those technologies, was found from other students' comments as well. Jenna, an English major, also mentioned her excitement that she had when she first learned about the convenient features of Moodle, a popular classroom support technology. Her statement revealed that she did not clearly understand the very technology that she was talking about. However, her statement showed her fascination about this versatile technology that she recently got to know.

> It kind of exceeds my expectations in that the website [Moodle] that we use for class... what is it called? It's like you go to the website [of the IT program], and you go to your courses, when you click on it, it has everything. We don't have to print out syllabus, it has everything up to date, and you can click on it, and you

> can use wikis, which I had never even heard of before, and those kind of things, stuff like that. It's just really organized... I just like it because it's kind of open-ended, and we were free to explore a lot of different things...

Participants' attitudes towards diverse IT uses were very positive. Dave indicated that he generally liked classes that utilized educational computer technologies a lot. He was viewing mostly the positive sides of the deployment of computers, such as "making things easier."

> I love using class technologies. That's what I really like about the IT curriculum. We use Moodle, I think it's a great program, that's something that creates access I can see what's going on, I can see the calendar and stuff like that. I enjoy it. It makes things easier. And also, in addition to that is electronic reserves. I've noticed that every class that I had so far had electronic reserves. That's big. I'd rather access the Internet, here it is, I'll print it off, than have the whole book, and read through. I'd rather like to have a nice little cutting edge article and go through it and look at it. I enjoy it. It's easier.

The positive view also appeared in Abby's excitement about paperless classes. One thing that Abby liked about using IT applications was integrating various technologies actively into school practices. Many previous studies already indicated that the general excitement about paperless offices in the earlier times of the Internet proved to be false (e.g., Sellen and Harper, 2001). However, the same early naïve hope for paperless classes was found in the college students' excitement about the potential use of IT.

> Because you do your project and you're done, you don't have to worry about taking a final exam... I like that. The work is all done online, that's another difference. Non usage of any paper, no books to buy, that's a good one, I like that one.

While focusing so much on the benefits of using computers, participants generally were not being very critical about the various consequences of utilizing computers. While students start to recognize the various potential applications of computers, they often fail to notice the various side effects of applying computers. For example, Zachary, a CS major, believed that he could get the same classroom experience by watching class

lecture online instead of showing up at a class. He insisted that he did not see anything he would lose by not attending a class physically. He believed that he could easily catch up on the class by watching the video-recorded lecture online and getting class materials from the class website. However, this attitude is risky, considering the assertions of many social learning theories that learning occurs through social interactions imbedded in tasks. Also, the focus of the many studies on e-learning was on how to make virtual learning as rich experiences as traditional classroom learning. Zachary stated:

> I am used to my CS courses, where not only our lecture notes online, some of the courses actually have videos of the lecture online. One of my courses I just never go and watch video in my free time and I still get the same experience. I guess the only difference is that I just can't ask questions on the spot. Then if I have questions I just can go talk to the teacher or TA or anyone. So I don't feel like I am missing anything by doing that.

As shown above, computers have become not just tools to do fun things and to do homework any longer. Students' positive expectations of computers as tools that would bring them a lot of benefits grow significantly during this period.

Participants' excitement of discovering various utilizations of computers has a thread of connection to their indifference to younger people's computer use, an attitude described in Chapter 4. Participants generally admitted that their younger siblings were very good at dealing with computers, sometimes even better than themselves, but did not care what activities the younger siblings were engaged in with their computers. Nor did the younger siblings' proficiency have any meaningful influence in determining their own IT competency. That was because they thought that younger siblings' computer uses were mostly for entertainment and miscellaneous activities rather than for any serious purposes. It implied that students put different significance on computers from that of what they had as young children. This apathetic attitude towards younger people's IT use supports the insight in this chapter that computers have different meanings for college students from what they had when young.

Often, the significance of computer skills and knowledge was expressed in terms of the relevance to students' post-graduation lives. One of the things that students considered

seriously for their post-graduation lives was their future career. Sometimes participants found a need to learn IT when they confronted requirements for their future job. For example, Janet said that she needed to learn desktop publishing programs because knowledge of those programs would be a big plus for her to find a publishing job. Brad found advantages of having proficiency in Excel, which would be beneficial at his future job in the commercial banking field.

As seen above, as participants came to college, they were exposed to diverse usage of computers. They started to be engaged in various activities on computers. Besides, having their own computers enlarged their autonomy of using them, which greatly encouraged them to experiment with different potential uses. As they started to realize different uses of computers, they started to consider computers as a significant tool that would bring them many further advantages in accomplishing their valuable goals. These newly recognized advantages were one contributing factor that made students seek formal IT learning opportunities.

5.2. Reasons for Seeking Formal Learning Opportunities in IT

5.2.1 Limitations of Informal Help Resources

As their uses of IT expand and recognition of the importance of IT use increases, college students actively learn different IT usage. Sometimes they learn by themselves, sometimes with other's help. However, even if students view computers as a tool to bring them many advantages, they frequently draw on help for learning new IT knowledge and skills first from informal resources, such as their friends and family. Actually previous studies on end users already have confirmed that friends are the most frequently referred help resources (e.g., Govindarajuju, 2003). Still, there were occasions in which that help from acquaintances were not sufficient. The things that they do not get from the informal help resources may point to a place for the role of formal IT education. Also, the reasons for finding informal help may suggest what formal IT education programs have to consider in guiding their students.

Not surprisingly, the most popular help resources mentioned were family, friends, and co-workers, people who are nearby. Participants mentioned that they would ask a person whom they already knew, rather than a stranger. For example, Ricky stated:

> I do not ask questions to nearby people if I don't know them [giggles]. Usually I go to people that I know first. Or at least whom I have contact with so I can feel familiar asking them for help, more so than going to a stranger and ask him to help me with programming.

This student giggled when he talked about his habits of asking help from people around him, instead of asking somebody more knowledgeable. It seemed that he believed that he should go ask a knowledgeable person regardless of the level of his prior relationship with that person, but did not often do so and just relied on friends and family.

A significant reason that people consult acquaintances is because they share common background knowledge and problem contexts to discuss computer questions. As Twidale (2005) pointed out, many computer problems are not easy to describe verbally. Therefore, sharing common situational contexts is a big advantage in understanding the problems and discussing solutions. These acquaintances from whom they asked for help were not necessarily people in the CS or IT fields. In the case of Brad, his father was the most frequently sought help resource. His father worked in the accounting field and shared area expertise with him. His father was not an overall IT savvy-person, but had some IT knowledge from his years of accounting work experience. As Brad was pursuing a job in the commercial banking field which is related to accounting, he felt that his father provided helpful knowledge.

> Although my dad is not that good at computers, [if I have problems] I will call him and ask "what would you do? Where should I go from here?" And he could lead me a direction or have the IT guy call me or something.

The biggest advantage of acquaintances is their availability. Frequently mentioned help resources were friends who lived in the same apartment complex, co-workers that they worked with, or family members that they communicated often with. Peers and co-workers who exist in the same physical space has advantage as a help resource because they can utilize the physical artifacts that exist in the space to improve their

understanding of the problems (Twidale, 2005). Emily talked about an instance when her roommate was the person to ask her computer questions. Her roommate may not have been a computer expert, but was around in the same space, and she could easily draw on her roommate's help.

> I didn't know how to print a screen, I asked my roommate who did know. So I ask whomever around knows that problem, or look at the help, or I call my dad. It's just easier to ask a person around. So I guess it's guessing what people would know.

Participants selectively asked IT related questions based on the help sources' area expertise. They usually knew what their friends were good at, and asked those friends who had special expertise in that area. Ricky stated:

> Probably I would go first to my peers, and find somebody who has competency in that area.... I suppose if I didn't ask anybody, I would ask, I guess... If I knew a professor well, [I would ask him]... I would find somebody who has competency in any area I am looking for.

When they find informal resources, a popular way of learning computers is just "going over" the specific part together with somebody who already has been using them in their tasks. It is a contrast to an overall review of computers. Brad described his learning experience with Oracle's accounting software when he was doing an internship at an accounting firm. His comments indicate that what he learned from his future boss was not something fundamental, about "the computer," but were some quick tips how he could carry out the specific task.

> She [his boss] didn't really teach me like "the computer." I wouldn't be with a great knowledge with "the program." She more taught me about the functional knowledge that was enough to do what I needed to do. I wasn't like "savvy" with it by any means.

Going over tasks that involved IT use together with an experienced person was reported as the most frequent way of learning IT. There are many occasions in which people teach IT usage to each other. However, verbalizing what they do with IT is often difficult, and

showing how to do is much easier. Twidale (2005) also points out the difficulty of verbalizing computer tasks as a major factor that facilitates informal help-giving interactions. He points out that the intensive GUI (Graphical User Interface) computing environment which has greatly improved the user-friendliness of computers in turn makes it harder for people to verbally describe the procedure of performing the computer tasks that they have at hand. Therefore, learners and helpers frequently just go over the tasks together without needing to verbalize the computer task. Tom, a Psychology major, described such an instance in which he just went over IT tasks with other student workers when he needed to train newcomers. He needed to use a computer graphics program, Adobe Illustrator, to perform his tasks in his part-time job. He generally did not enjoy using technologies, but indicated that he had to use it to accomplish his tasks. When he needed to train somebody else how to use this application at his work, he went over the tasks with the person, mainly because it was hard to verbalize what he normally did with the technologies at work.

> Tom: I don't enjoy using Adobe at all. Hahaha... But I know how to do it, and I tried to teach someone how to do it, I didn't really know how to teach them how to do it. It's a pretty complicated program.
>
> Interviewer: You need to teach it to other people?
>
> Tom: Yeah. I was trying to teach another student worker how to do it.
>
> Interviewer: So you mean that you can do what you need to do with Adobe, but it's kind of hard to tell other people how to do...?
>
> Tom: I can do what I need to do and get it done, but it's hard to explain it.

The above examples showed that what is exchanged in informal help giving interactions is a small piece of knowledge that is necessary to carry out a specific task. Informal help resources provided participants with quick fixes and practical one-time help without needing to go deep into any theoretical ground. While this was an advantage, students desired to learn something more than quick fixes and simply going over some tasks together. As students realize that computer knowledge and skills are something important, they perceive that computers are not a trivial thing that they can fully appreciate by just

"going over" together with other people. This perception contributes to their willingness to get formal instructions.

5.2.2 Instances of Looking for Other People's Guidance

In Chapter 4, it was shown that most students had strong preference to self-guided learning when they needed to learn something on a computer. They preferred to acquire IT knowledge and skills by self trial and error. They also expressed strong confidence in their self-learning abilities. When they needed help, they frequently asked help from nearby people or acquaintances. However, there were instances in which participants wanted to get guidance from other people who had expertise in IT or who had some sort of authority in certain fields. The reasons that they would like to find experts' or authority figures' guidance may be a starting point from which their rationale of pursuing formal learning opportunities in IT can be inferred.

First, participants indicated that they would look for knowledgeable other's help when they had to learn something that was not very interesting to them. It was a contrast to their remarks that they would try to learn technical skills by themselves regardless of their difficulty level, if the skills were something that interested them. Brad stated:

> If I don't like it [the thing that I need to learn], I definitely prefer to ask. But if it is something that I am relatively interested in, I'll look around, read some stuff on it, and do it that way. But if it is something that I have to learn but I really don't care to, I'll definitely look for help.

Another occasion in which participants would look for others' help was when they needed to learn something complicated and difficult. In this case, the person to whom students would rely on for help would be those who have technical expertise. Students indicated that they occasionally found help when they were trying to learn something difficult, such as a programming language. Jenna stated that she would prefer to ask a teacher and get a step-by-step instruction in case she needed to learn programming.

> I'd say it's hard to learn computer programming by yourself, because you're looking at step-by-step instructions, and it's hard to follow... It's better if someone like a teacher is there, shows an example on the board. With XML, there

> is like a tutorial online, and that helps with just referencing it and looking at specific specs, but for actually using it, we did examples like a recipe, we did a recipe online through HTML and then it showed up as a web page. When we did that, then I was able to figure it out, like grasp it a little better, instead of just reading the tutorial.

Third, students would find other people's help when the IT task is something important for their future. In this case, the people that students would ask for help were authority figures in certain fields. Like many other students, Dave strongly preferred to learn IT by himself. He indicated that he would figure things out by himself most of the time, or ask his friends when the problems were related to his leisure activities.

> My best friend actually is really good at computers as far as Codecs and coding stuff because he is a CS major at Eastern. I can make my own DVDs, he helps me if I have problems with a certain DVD, that doesn't want to be copied. He knows what to do. He knows what to do, like you need to run it like this, he's really, as far as trouble shooting, he's more of a technical guy.

In contrast, Dave indicated that he would find other people's guidance if the problems were related to important activities for his future life. For example, he felt that knowledge of GIS (Geographic Information System) would be something important for his future career in the government. Therefore, he wanted to get an external guidance from an authority figure in that field when he tried to learn the system. He described his experience of learning a GIS at his part time job at a government office in comparison with his experience of working on his leisure activities:

> It depends on what I was doing. For instance, both of those [Xbox 360 and Photoshop] are leisure activities, so I would prefer do it by myself and figure it out. Something like I can see in the future, like the GIS thing that I was talking about, I'd rather be shown how to do it, like somebody tells me how to do it at the first time, so I can be more efficient. So I think the difference depends on the contents.

Because he envisioned that the knowledge of GIS systems would be important in his future as a government employee, he was glad that his boss went over the system with

him. It was not because the GIS system was difficult to learn, but because that was something important for the tasks that he was conducting.

> The thing that I worked with at the assessor's office, the GIS thing, that wasn't too hard to pick up. Usually my boss showed me for the first time, after there were a couple of questions, but that was pretty easy to pick up.

Similarly, Brad stated that he had considered taking another CS class that would focus on Excel after taking an introductory CS class, even though he was not very much interested in obtaining further computer skills. The reason was that he had noticed that well-engrained Excel skills were considered very valuable in his future jobs. He thought that having proficient Excel skills was important, because it might be a good way to impress his future employers, and would enable him to directly play an active role in his job without needing to spend time to acquire basic workplace skills.

The findings described the instances in which students would find other people's guidance, especially from people who are technical experts or people with authority in certain fields. These instances may provide a foundation to figure out the reasons that students would seek formal education in IT. Students would seek external guidance when the knowledge and skills are something that they are not much interested, when they are complicated, or when they are something important. Those people to whom they would ask for guidance were authority figures, either knowledgeable in technical subjects, or had authority to verify the knowledge is important in carrying out certain tasks. These findings may be related to the reasons that students would seek an opportunity for formal IT education, rather than learning informally with help of acquaintances or by themselves.

5.2.3 A Desire to Get a Comprehensive Understanding of IT

A desire to get a more comprehensive understanding of computers was reported by many participants when they expressed their interests in getting formal IT education. This desire often had to do with the almost ubiquitous existence of computers. Computers easily available at the hands of non-technical people sometimes draw students' attention to a need to learn computing, who might not have been interested in computing before

computers became so widely available. Such a case was found from Claire, who was a serious English major who was considering continuing her study in English to a doctoral level. Her intensive use of computers in everyday life made her curious about how computers work behind-the-scene. This interest in getting a comprehensive understanding of computers initially led her to consider taking an introductory CS class.

> A few semesters ago, and I don't remember what it was, might have been introduction to computer science, but it didn't fit in my schedule. I've always been interested in learning more about computers. I didn't have any idea how computers actually work. I like computers... [but] I was too scared of taking CS classes, because I don't feel like I know enough about computers.

Claire's hope to get a comprehensive understanding through a CS class was an exact contrast with Abby's experience of asking a specific problem to her co-workers. When Abby had a quick question in the context of performing a task, she just asked other people around her.

> When I have only one specific question, like how do I crop this picture, I would ask a person sitting next to me.

Claire mentioned a CS class as a way to get comprehensive understanding about computers before she learned about the existence of the IT program on campus. Although her interest did not have to do with programming, she had envisioned that a CS class might be a place where she could get such a comprehensive understanding of computers.

Another English major, Kate, also expressed her desire to obtain such a comprehensive understanding about computers. Her main reason for wanting to get such an understanding was because she always had felt behind in terms of computers in general compared to her peers. For that reason, she took an introductory CS class regardless of her lack of knowledge and interest in computers. She felt that way not because computers were something she wanted to learn, but because what she needed to learn. She repeatedly said that the CS class was very hard for her and not enjoyable.

> Because I usually want to learn about computers. I just feel like I am behind, because I really didn't use them in high school. So when I came to knowledge, I

didn't know anything. I needed to make myself better put on my resume. And my roommate took that class and recommended it to me.

Feeling of being behind in terms of computers also motivated Jenna, another English major, to seek an opportunity to get a more comprehensive understanding. She indicated that she would consider taking an introductory CS class that would teach her computer basics, because she wanted to obtain some fundamental knowledge about computers.

> Actually I was thinking that I would like to take an introductory course with the basics of computers. You know when I had asked you what is hardware and what is software. Just basic things like that, because that's the kind of thing that I feel that I was lacking whenever I was in 201 [an IT class]. Just the basic fundamentals. I don't know what you would introduce but... maybe even when you talked about "hardware" you think I know what that would mean. When you talked about it I was really like...I don't know if you can make a whole course about it, but it's nice to clarify just the basics of computers, not too basic like "what's Word," you assume that they would know that but maybe...

Participants' statements above indicate their strong desire to get a comprehensive understanding of computers rather than have their quick questions answered.

5.3. Perceptions of Short Computer Training Opportunities

The desire to get a comprehensive understanding of computers was a contrast to the reasons students would take short computer training opportunities. There is another formal opportunity that provides computing instructions on campus other than regular classes. The university has kept a large dedicated IT support unit to provide various computer and telecommunications support. Many computer training opportunities have been offered through this unit as services for students, faculty, and staff. It offers short instructions on a range of topics and on a different level of expertise.

However, participants pointed out that there were many limitations in those short training sessions. One theme that was clearly drawn from participants' unsatisfactory experience with these opportunities was their desire to get a more comprehensive understanding over

a variety of computer-related topics. The shortcomings pointed out about the computer training sessions indicated that participants wanted a different learning opportunity which might help them figure out a bigger picture of information technologies and their uses.

One way in which the limitation of the short training sessions was manifested was the low percentage of participants who had ever taken this opportunity. Students rarely mentioned this service as their potential help resource that they would draw on. While a CS class was mentioned by more than 20 interviewees as a potential help resource, this short training opportunity was mentioned by only seven participants. This low popularity signaled that students' awareness of this short IT training opportunity was minimal.

Even those few students who had tried the training sessions did not consider those classes very effective. Most participants pointed out that short training sessions were effective for students who had at least a certain level of technical expertise and knew where their knowledge gap exactly existed. Therefore, short computer training was not perceived effective if learners were not able to pinpoint the areas that they needed to learn.

Only students who were already sufficiently experienced with technologies reported that this one time training sessions were effective. The instances in which participants found short training effective were mostly in their work contexts, in which the purpose of attending the training classes was very clear and well-defined. Matt, a Computer Engineering major, described his experience with training sessions at a fortune 100 IT company when he was working for the U.S. Navy.

> It [the short training session] was for a piece of encryption equipment that we used at work. I learned from having no knowledge on that piece of equipment to learning how to run the program, set it up, everything else.

Nathan, another Computer Engineering major, talked about an instance in which he had considered attending a training class on a version control system called Clearcase. He already had plentiful background knowledge of computers, and the specific application was required from his job as a computer engineer, who would take care of different versions of software.

> There was one that I meant to go to. It was on Clearcase. I think by the time I was going to take it I already learned just about everything and I could have taught the course. Because my job focused on using this.

The above instances showed that the short training opportunity is more effective for making up for a specific knowledge gap, rather than for helping students get a bigger idea.

Less technically experienced students who did not have such clear ideas about what to learn did not find short training opportunities very helpful. As the subjects of the short training sessions were not closely related to these students' tasks, the short training sessions did not make much sense to them. Kate, an English major, found out about a short computer training class on Dreamweaver from her advisor through an email announcement sent out to the students in that department. From her statement, it was clear that her expectation for the workshop was to get comprehensive knowledge of setting up a website using this tool, rather than getting some quick tips.

> Actually I just wanted to take it [a Dreamweaver workshop from the IT services] to help me with grad school, because I did learn how to make a webpage last semester in a group making a web site, and I just had no idea how to do it. So it does mention of Dreamweaver so I thought it might be a good thing to know, in case it comes up again in a class project.

In the same context, IT techniques taught in those training sessions were not perceived very useful, because they were mostly pure techniques that were context-free. Instructions that focused on teaching technical skills without explaining their use context were not perceived to be efficient. Applying the knowledge to their own problems was still up to students themselves even after attending the sessions. Kate above pointed out:

> After all, it's all up to me. It was not very helpful... not really... hahaha... There was a student teaching it, he seemed pretty unorganized. I understood a lot of what he was saying, but he was just showing different tools, instead of doing it coherently. I came out knowing basically how to do it. I have a guide book that can help me do it. I am sure I can figure it out. Just probably need to take time on my own and explore around it.

Also, the scope of a short training session is narrow and focused by its nature of being short and one-time. While students have diverse computing issues, the short training opportunities cannot cover the wide range of issues. Jack's comment implied that the short time span of the training sessions should focus on only one small part of the computing issue.

> The class [a short computer training session] is only about an hour long, and it was a very good introduction, but for a lot of the Pro applications, especially problems for final cut studio use for video editing, there's no way you can learn all of the skills under an hour. It was a very good introduction but it also made me realize how much more work I would have if I want to learn those.

Larry commented that it was hard to find a short training opportunity that exactly corresponded to his interests, due to the short training's narrow focus.

> I am pretty competent with what I need to do, and they really haven't offered me anything that either I am interested in, or that's relevant to what I am working on.

Similarly, Janet was planning to pursue an editing job in a publishing company, and she felt that she needed to learn Quark, a desktop publishing program. She was disappointed to learn that the short training sessions did not offer any class on this specific program used in the publishing industry.

> Um... the reason that I haven't had them is... probably because they don't have what I am looking for... the other day I was looking at, see if they offer a course on Quark but they don't. So that's probably why. Other than that, it's because I already have enough knowledge about whatever programs that they are offering.

This unmatched focus caused a perception that attending the training sessions was time consuming and just a hassle. As Dave stated:

> I figured that probably it's too much of a hassle. If I need to really figure out something, I can search online. And I wouldn't have to physically displace myself to figure something out. I guess, I am home and sit. One or two pieces of printed information in one or two hour session, maybe it's probably not worth the time.

Related to the narrow scope, students also pointed out that one-time instruction of these sessions was one of the biggest limitations. Instead, they wanted some instruction that spans over a period of time, so that they can practice and go back for questions. As Kate stated:

> I can go to ask for help if there were more than one session. I think definitely need time to do things about software.

Consequently, short training sessions are not perceived as a very useful opportunity to the general student population. As the training was not directly related to their current concerns, the opportunities did not attract their attention. Participants stated that they could not take the training because they lacked time, but it was actually because they were not very interested in such training. Participants argued that they did not have time to take the instruction, because their schedule was full of other important things that had priority over attending an IT training class. They did not find a justifiable reason enough to fit it into their busy schedule. As Emily, a Psychology major said:

> I'm just so busy... I see that they are offered, but I don't really need it. And I think that my computer skills are good enough. I won't really gain anything from it. The thing is, my schedule is so full. I don't have any motivation to go for it, and I don't have time. I don't even know what they're doing in them, but I know it's there. But it seems that there are millions and millions of things to do on this campus.

Therefore, these short training opportunities were not perceived to be effective for two major reasons. First, those training's narrow focus is not applicable to students who desire to broaden their overall understanding of IT. Short training sessions may be helpful for people who are already quite knowledgeable and able to pinpoint their specific knowledge gap. However, it does not provide general guidance to less knowledgeable people who want to obtain a comprehensive understanding in the long term. Second, one time instructions, the most frequent form of the short training sessions, does not satisfy students' needs for an opportunity to learn computers over a period of sufficient length. Participants wanted an opportunity that would allow them to have continuous interactions

regarding their IT-related problems. These limitations support that students would see a formal IT learning opportunity valuable.

5.4. Summary

The significance of utilizing IT dramatically changes as students begin college. Computers are no longer just a gaming or typing tool, but have become more diverse entertaining and versatile work tools that would bring them significant advantages. As they start to see the benefits that the use of computers would bring, they consider computers an important subject to learn in college.

As their uses expand, learning occurs actively. Previous studies and the interview data together indicated that most of their IT learning occurs informally through personal exploration and interactions with peers and nearby people. Sometimes students need other people's help especially when they try to learn something difficult and not necessarily interesting to them. They especially feel that they need authority figures' guidance when they learn skills and knowledge of IT that they feel important for their future.

Implied from their comments about the effectiveness and limitations of various help resources was a desire to get a comprehensive understanding of computers. A more comprehensive understanding of computers was desired as they realized that computers have become the tools that they have to embrace in their lives. The desire to get a comprehensive understanding was also confirmed from the perceived limitations of short computer training opportunities offered through the campus IT support services. In spite of the well-established presence of the short computer training sessions, this training opportunity did not satisfy students' needs for computing education in many ways, especially in that it did not serve as an opportunity for students to obtain a comprehensive understanding of computers. The fact that informal learning resources and existing IT learning opportunities did not satisfy students' need for computing education constituted a reason that students would seek an opportunity for formal education in IT.

6. PERCEPTIONS OF EXISTING OPPORTUNITIES FOR COMPUTING EDUCATION IN COLLEGES

Several computing disciplines have existed in colleges, since long before IT programs emerged. Among the computing disciplines, Computer Science (CS) is the most prominent one. It is reasonable to examine how students perceive current CS education, because an IT program has been understood in some relation to CS which has a long history of computing education.

In Chapter 5, it was found that students seek formal computing education in college because they feel that skills and knowledge in computing are important to them, therefore they look for a CS class to have an opportunity to obtain a comprehensive understanding of computers. Literature has pointed out that people's ability to perform versatile tasks with computers is usually obtained through their intensive experiences with computers over time (e.g., Twidale and Nichols, 2006). When students feel that their understanding coming from those experiences is limited, they look for a formal education opportunity to obtain a comprehensive understanding of computers. In this chapter, I examine what perceptions students had regarding traditional Computer Science programs. Perceptions of college education in general in relation to education for IT are also explored.

6.1. Perceptions of the Computer Science Program

Interview data showed that many students from different majors had tried an introductory CS class, or had considered taking a CS class for reasons that are different from the reasons of finding simple help in learning IT in everyday contexts. The major reasons included getting a more comprehensive understanding of computers as they recognized that "computers are everywhere and learning about them would be beneficial." Seven technical majors had taken at least a CS class as one part of a requirement of their major. 20 out of the other 21 non-technology majors said that they had taken an introductory CS class, or had considered taking one. The reason that such a large percentage of students had tried or had considered a CS class should be that CS has existed in college for a long time and has well-established its presence on campus. The title of the CS class that many

participants from non-technical majors mentioned was "Introduction to computing for non-engineering students (CS 105)," which is offered at an introductory undergraduate level. Students' main purpose of considering the introductory CS class was to improve their overall understanding in computers. Some other participants had taken other low-level CS classes because they had considered CS as their major or a minor. Most of them determined that the traditional CS education did not satisfy their needs after taking one or more CS classes. Why did CS classes not respond to their needs for computing education?

6.1.1 Emphasis on Fundamental Computing Principles

Participants who had taken a CS class commonly felt that CS classes were very difficult, most frequently because of the fundamental computing principles taught in the CS field. Even those students who have had plenty of previous experiences with computers reported that they found CS classes very difficult. Those students had considered doing a major or a minor in Computer Science, but changed their mind after some trial because of the difficulty. For example, Chris, a Philosophy major, had been engaged in diverse activities with computers since he was young. His intensive experience with computers led him to come to the university with a CS major, but he later switched his major. He found that CS was very difficult even though he already had extensive experiences with computers before starting college.

> I joined the university with very sporadic knowledge of computing. I had built my own computers, and I had fairly good knowledge of hardware systems. I had fairly good knowledge of coding and software systems as well, which would lead me to an interesting... However, computer programming courses in computer science department are notorious for being exceedingly difficult even for people who already know the basics of programming.

A lot of difficulty comes from the intensive math requirements that are considered as a core part of the CS curriculum. CS educators often argue that computing is all about abstraction, and the best approach to enhance students' ability to do abstract thinking is intensive math training (e.g., Devlin, 2003; Kramer, 2007). Aaron, a History major, had considered doing a CS minor when he was a freshman. His father worked in the IT field,

and he intuitively thought that doing a CS minor would not be a bad idea. However, he found CS classes very difficult after taking a couple of required core classes for the CS minor. His second CS course, another required core course for the CS minor, required even more math than the first one. Because of the heavy math requirements, he felt that that class was an analytic math class, rather than a CS class. Finally he determined that CS was not where his strength was, and changed his mind not to continue the CS minor.

> I didn't care for it [a core CS class for a CS minor] very much. The JAVA coding was not one of my strengths. I got to the class, but I always felt like it was hard, I always had to be... I spent a lot of time on manuals trying to understand how everything works. I really struggled on the exams because it's hard to remember how to code something. I ended up with a C in the class..... I also took CS 172, which is an analytic math class. It really wasn't a computer science course. It was just a lot of analytic math. I didn't like analytic math. So pretty much at that point I decided I am not gonna continue with the computer science.

Aaron's experience in CS was compared with his later experience in an IT class, where he learned HTML and other web technologies. He said he enjoyed the IT class much more than the CS classes because the IT class did not require students to learn many abstract math concepts while still dealing with computers.

> But the HTML stuff [in IT classes] makes more sense, because it's pretty much basic format, you're not worrying about recursion or really abstract computer science skills.

Some students actually found CS difficult after experiencing some classes, but other students had a strong pre-established stereotype that CS is hard and intimidating. For this stereotype, some students shut themselves off from an exposure to CS before even trying some CS classes. This perception is often influenced by the stories they hear from their friends. Lauren, a Sociology major, also considered herself not fitting in the computing area. She justified her thought with a story she heard from other students.

> It doesn't seem like something that has to do with my major, or something that I wouldn't be interested in. It doesn't appeal to me... and I also heard bad things about them... they are difficult... [laugh]

As seen from Lauren's remark, CS classes actually are difficult, but students used the stereotype to justify their reasons for not trying any CS class. For example, Taylor, a sophomore student, commented that CS is very difficult from what he heard from his friend who is in the CS field.

> I've got a friend who is a Computer Science major. She is constantly talking about a large workload. And I've got a couple friends who are CS majors, who have classes like 8 to 7. So it's a rough day. That's his Monday... He doesn't really have a lot of class for the rest of the week, but Monday is kind of rough.

In Taylor's description, the rough day when his friend had to be in class from 8am to 7pm was only one day of the week. However, he talked about this episode to justify his thought that a CS class was very difficult and hence was not appropriate for him.

Overall, students' descriptions of their experiences show that the heavy math requirements which are emphasized as a means to improve students' abstract thinking skills work as a strong barrier for students who want to learn about computing through CS classes.

6.1.2 Focus on Theories, rather than Practical Applications

It is commonly believed that Computer Science is a practical major that directly leads students to well-defined and well-paid career paths. For example, the recent edition of the Occupational Outlook Handbook that is being published biannually by the U.S. Department of Labor predicts that computer scientists and systems analysts will be among the fastest-growing occupations through the year 2010. However, the participants reported that they felt that CS was not practical education because it took a very theoretical approach and did not teach anything practical. Eric, an MIS major, admitted that CS education was valuable in that it provided solid foundations of computing, but commented that it did not teach those things that he could immediately apply.

> CS education is valuable in that it provides a solid basis of principles of computing, but still CS is focused on time-consuming design process, while rapid application development methods are available.

Eric's background explains how he arrived at this judgment. Eric explained that he happened to learn about business opportunities with web design when young. He learned different computer languages by himself, from the books he purchased from local bookstores. Then he directly went into entrepreneurship while in college, establishing his own company that does web design. He already learned that he could run a business with web technologies without receiving intensive theoretical training in CS. With that as evidence, he emphasized that CS was not very practical training.

Sarah, a CS student who worked as a student webmaster in a student services office on campus, pointed out that she did not see the visual consequences of her programming work in classes very often. In contrast, the visual consequences were what she always saw at her webmaster work.

> For classes, you don't really have to have visual aspects of all the codes. You will have to calculate things, or figure out a formula that'll work quickly to do something, whereas here you can see results and cool things happen. Not that I don't love my classes and cool things happen, but it's less visual.

Students' statements indicated that there is significant inconsistency in the usage of many computing concepts between CS and everyday usage. Chris talked about his experience of looking for a class that teaches computer networking. As a freshman who brought a lot of computer skills and knowledge from informal settings, he was eager to learn how he could connect computers and have them communicate with each other. After some search for classes, he was disappointed that there were no CS classes that would teach him how to set up computer networks.

> What I really liked was any kind of networking knowledge. From what I can tell was, there really wasn't a course where I can sit down and they would teach me about packets and routers and hubs and switches and all the different inter-computing communication.

By learning "computers," participants hoped to be able to create some immediately usable applications that they could use in performing their important tasks. They turned away from CS as they learned that taking only one or more CS class would not make them become able to create digital applications on their own. Kelly, a Media Studies

major, heard about very arbitrary assignments that her friends had to deal with in a CS class. She did not want to deal with them, as she wanted to learn something that she could utilize immediately.

> I have thought about taking a CS class... It keeps me away from that. My friends have taken them, they come home talking about their really arbitrary assignments, things that are not gonna help them. I didn't want to deal with those assignments. I want to learn how to really get end up and do something that I can actually physically use, create a product.

A desire to teach and learn practical computing skills in college was apparent in a popular misleading expectation about CS. This false expectation was that people would become able to program on their own by taking one or two CS classes. The misleading expectation is prevalent not only among students, but also other educators in colleges. Emily's experience told about such trouble, as her advisor recommended her a CS course so that she could build a computer application for a psychology experiment.

> I was wanting to take a class on computer programming, but neither CS 105 nor CS 125 seemed to be what I wanted. I was working on a psych thesis, and it involved creating a program to make various boxes and pieces to appear on the screen, and the program that we're using had a visual interface that you could use to move stuff around and create the program that way and the computer would generate the script, but my advisor suggested that it would be useful to take a computer programming class, so that I wouldn't have to use the visual interface because the visual interface is kind of creepy. I really wanted to make something that works, but taking one programming course is not enough to do that. So I actually signed up for CS 105, but after two days in the class I decided that I didn't want to take it.

Even some CS educators try to market their classes appealing to that unrealistic expectation. Dave illustrated the class atmosphere of one introductory CS class that he had tried before. Dave, a transfer student, was a business major in his previous college. He tried to take one CS course, hoping that the CS class would help his study in business in some way. What drew his attention was the title of a CS course that was being

advertised to students. It was "Dot Net Programming." The advertisement for the class was an attempt to sell the course to students by advertising it as a business-related course.

> The advertisement said, "it helps your business career." It turned out that the course was strictly about programming and nothing about business. I felt cheated.

From these episodes, it can be seen that the misleading expectation about the CS program is pervasive across different groups of people on campus. It is not just students who expect that taking one or two CS classes will make them be able to create applications on a computer by themselves. It is also educators, who believe that taking a few CS classes would make their students capable of programming. If the false expectation about CS education is so pervasive, it may be a signal that there is an unidentified need for computing education, which may be substantial.

It was not only non-computing majors who felt that CS was not practical. Participants from the computing disciplines also felt that they needed to acquire something more than just classes before transitioning from school to the world beyond education. In this sense, they commented that the CS program did not prepare them for that transition sufficiently. Nathan commented:

> I want to learn Ruby and Python, and a couple others [other programming languages], because I think the more that I have access to, I learn more of what they can really be good at doing, and better I know how something could be done effectively and efficiently... I don't want to waste my time at my job doing it, really long, complicated way with a language that I don't know well. I can do it in a short simple way with a language that I am used to. There's definitely a big technical IT thing that I still would like to learn....

The intensive CS training is very much focused on teaching fundamental computing principles, and does not teach other skills that CS students would need when they try to put their academic training into practice. One such skill mentioned was communication skills. Another CS student, Sarah, told about this type of knowledge that was not being taught in the current CS program. When CS work is put into practice outside of the academic world, it is no more solitary work. Work of a computer scientist needs to be coordinated with other people's work. Therefore communication skills become very

important. However, her comment indicated that the CS program does not teach other essential skills necessary to carry out computer science work, such as persuasive speaking.

> It [working with other people at work] is sometimes challenging especially because in CS department we don't get taught persuasive speaking at all, I think along those lines, and sometimes it can be hard to express technological ideas and comment on it, a way for anyone to understand.

Not all the college classes need to have this practical orientation, but students expressed a strong desire to learn IT skills and knowledge before graduation as a way to be well-prepared for the real world of work. Participants felt that universities do not teach practical knowledge. Emily, a Psychology major, told about an interesting suggestion that she had heard about learning programming. She said that a good place to learn basic programming language without becoming a CS major was a community college.

> I wished that they offer a class through the IT minor like basic programming, like basic in C++ or whatever. Because I heard that CS classes, like the 105, which is for non-majors, you only learn about basic Excel and some basic SQL stuff. And the 125, which is for CS majors, it's theoretical and difficult. Actually I've heard if you want to take a basic computer programming class, the best place to go to is Parkland [a community college in the same campus town], because they teach you how to program without all the theoretical stuff. They teach practical stuff rather than theoretical...

From the participants' comments, tension between the CS discipline and other people's expectations for CS education was observed. The CS discipline aimed to nurture well-grained computing professionals who were trained with foundation principles of computing. However, other groups of people on campus wanted an opportunity to teach and learn practical computer skills and knowledge. These people included not only students, but also other educators. This mismatch was reported by students within the computing disciplines as well. While the CS program wanted to focus on teaching fundamental computing principles, its students wanted to acquire broader practical skills and knowledge that other people expect them to have.

6.1.3 Negative Images about Working in the CS Field

Tediousness

Another difficulty of CS classes that students reported was tediousness involved in many problem solving processes, such as fixing small errors in programming. For less experienced programmers, the small errors in programming are not easy to locate and take a long time to fix. Sarah, a CS major, mentioned such difficulty of fixing a small error. It occurs frequently in a CS class and usually requires long hours of efforts.

> There's a lot of really really smart people, and it can get intimidating sometimes, because people get things instantly and you might have to work on them, or you might be stuck in a problem and a project that you're given. It might take hours to figure out. It might be a "simple" little error, and you just can't find it. And that can be really frustrating, but I think it's a part of it.

Andy, a Political Science major, also described that the process of fixing small errors took days. He was a Political Science major, but also was a typical computer geek who did many computer related activities from his inherent interest in computers, such as building up to date computers in his leisure time. He mentioned that he even considered choosing CS as his major when he first enrolled for this university. However, he decided not to, mainly because of the tediousness involved in CS work. Still he was thinking about learning programming occasionally, but he still thought that he did not like it.

> But I found that I didn't necessarily enjoy it [a computer science class] very much. It's just very tedious work. I am not sure about the payoff of finally getting the program to work, it's worth 2 or 3 days of breaking your brain.

He compared work in the CS field to the work a cog or a machine would do. Instead of the tedious work, he wanted to do something that he could discuss and collaborate with people.

> I heard that Computer Science will be more restrictive, and you're more perhaps a cog, machine that tries to get work done on a piece of project, that has very

> specific goals about what you need to get done, and time frame, that might be somewhat harsh.

Many participants reported that CS was not very attractive to them because of the tediousness. The tediousness was an exact contrast from a creative work that many participants desired in other parts of their interviews. While many students said that CS was not very attractive, there were a small number of students who liked CS. Unlike typical perception of being tedious, these students who liked CS were framing the CS field as a field that allows a lot of creativity. For example, Sarah, a Computer Science major, said that she liked computer science because she could take different ways to arrive at a final goal creatively.

> I can do it in a billion different ways. I can make it faster, or I can make it more reliable. It's about optimizing things. It involves a level of creativity. I cannot stand to always do math and put formulas in.

This CS major believed that her computer competency allows her to try different ways of problem solving and gives much control over her programming work.

> I think I actually have probably more creativity, I think a lot of them might be faster at "this is maybe the optimum way," but I think I can find creative solutions. But they might not be an already set way to do. I do feel like I can say "Okay, you can do it that way, but maybe this way will work," and then just try it. And if it doesn't work, you can have the things you don't work, so it doesn't matter, you just try something.

From participants' comments, it was seen that the tediousness perception actually is a subjective perception, rather than reality. Depending on the way they framed Computer Science work, some participants found it very tedious work, while others considered it creative work. A majority of non-technical majors considered that CS work was very tedious, and determined that CS did not satisfy their needs for computing education.

Isolation

Another popular stereotype of CS was that it always requires working alone for long hours, which does not allow programmers to have many social opportunities. Many tasks

in the CS field are increasingly performed collaboratively, but still there is a strong stereotype that computer work implies isolation, sitting long hours alone in front of a computer screen without any social interactions. CS educators already have recognized this strong stereotype of working alone is very persistent and almost unshakable (e.g, Blank, 2006). Dave generally enjoyed dealing with technical stuff, but firmly asserted that he would not choose programming for a possible career path. The major reason was that he saw programming as a solitary endeavor.

> Programming is a good skill to have. It's not something like for sure going for career, no way. I thought it's too dull for me personally, because it's solitary. I feel like I have more social skills. I would rather talk and interact with people on group work, than have just me in a closet with a computer.

He showed a strong desire to play a coordinating role for a group of people, which possibly would include programmers. He felt that his biggest strength was his social skills; bringing people together, giving a group comfort, making them talk, and sharing information with each other, and so on. However, he did not want to do programming himself. Instead, he indicated that he wanted to work with programmers on technical problems.

The participants understood that being solitary was just a stigma rather than reality, but as was indicated in Dave's statement, this stigma made the CS field less appealing to students. This was also expressed by Andy, who was very adept at computing. Andy emphasized that the lack of social life, rather than the difficulty involved in CS work, was what made him not attracted to the CS field.

> Of course there is this stigma with many computer scientists that they have no social lives, instead there's a certain amount of programming. That didn't bother me, but it's certainly not appealing.

That leads to a perception that IT is not a career path for a "people person." Many participants mentioned that they did not want to pursue any IT-related career because they would like to work with other people rather than working alone.

It is interesting to see that college students' perception about the CS program was being heavily influenced by their perceptions of IT work. The fact that their perceptions of IT professionals' work influenced their willingness to study in the IT field also confirmed that students viewed the significance of computing education in relation to their study and work, rather than to entertainment and everyday social uses, which was pointed out in Chapter 5.

A Concern for Ending up Being a Technical Support Person

Another popular image of IT work was a computer technician's role, which takes care of other people's technical problems, such as system support, server administration, network administration, or fixing hardware problems. To participants, an IT person was perceived to be a technician who provides technical support to other people as technical problems arise. Brad's description of an "IT guy" at a dorm showed students' typical perceptions for the roles of an IT support person: An IT support person stands by for other people's call for help, connects their computers to a network, and fixes their hardware problems. These supporting roles in an organization, rather than a leading role, did not sound very appealing to many students.

> I know in my freshman year when I lived in a dorm, the guy who lived in the basement, he was kind of an "IT guy" for the building, he would come around and install software when you move here…

Zachary, a CS major, tried very hard to differentiate CS work from IT work. He showed a strong preference to focus on programming, and showed a strong dislike for IT jobs. He argued that CS is all about programming and IT is not such a field. "It [an IT job] is not really programming of anything which is really what Computer Science is."

In general, Zachary perceived that "IT guys" in an organization provide technical supports to other staff, even to CS staff, rather than playing their own active roles.

> Most people end up with working at a bank, but I want to concentrate on programming… They [a gaming company that he has applied for] have specific IT people, that run stuff like code repositories and knowledge base, separate from computer science guys. They just use them and they don't really know what's

> going on..... For computer science jobs, you kind of use it, but you really don't have to know about it. Um... you [a CS guy] basically say, "I need the code from 1995." They [IT people] say "here it is," and you take it. That's it. You don't really have to know anything about it.

Also, he described that IT jobs are what CS students eventually "end up" with, instead of being one of their best choices.

> It's like an IT department in a bank or something like that, that guy has to run servers and do all kinds of stuff..... It is not really programming of anything, which is really what computer science is. The theory of programming... Running servers isn't so much computer science. It's more of... um... computer technician. A lot of people end up with those kind of jobs, and they figure it out by taking a course and see where it goes.

For him, as a computer science guy, IT tasks were not very pleasant to do, as IT stuff was computer technicians' work in his mind. However, he recognized that the IT work as something that he would have to confront later, if he liked it or not.

Other tasks that participants contrasted with "IT support work" included "entrepreneurship," and "being my own boss." Eric, an MIS major who was running his own web design business, stated that an IT support job would be his last choice for his career.

> Systems' analyst job is something that I basically fall back on... There's too much entrepreneur in me... I wanna be my own boss, run my own company, ideally what I'd like to do is starting my own company that is kind of business solutions I talk with businesses and then provide the technology to meet whatever need it is that they have.

As examined above, work in the IT field was not very appealing to the participants in many ways: IT work allows less autonomy, requires a supporting role rather than an active leading role, and is usually considered as a computer technician's work. The negative images of IT work influence students' perceptions of the Computer Science field.

To summarize, the strong stereotype of IT work as "technicians' support work" made students not attracted to any IT work.

It was found that the negative images that students have about IT work decrease their interest in IT education. They understood that IT education did not require them to become IT professionals, but still the stereotypes of IT work strongly influenced their perception of this field. Occupations in IT are often described as having a very good job prospect. However, both technical majors and non-technical majors generally viewed those jobs as non-appealing occupations. Students' perceptions about the IT field of study were being heavily influenced by their perceptions about IT work. However, the increasing IT job opportunities made students more familiarized with the popular stereotype.

6.1.4 Atmosphere of CS Classes: Not Newbie-Friendly

Students said that the class atmosphere in CS classes was not very friendly to newbies. The newbies to CS classes included two different types of students. One type of those newbies are computer novices who have less technical expertise. Another type of newbies are those students new to CS classes but have had considerable expertise in dealing with computers. CS classes are not very friendly to both types of newbies. One English major, Kate, talked about her experience where she got totally lost but could not get any guide in the CS class. She belonged to the first type, and was not familiar with computers at all. She complained that the CS class she took did not care about concerns of novices like her.

> I didn't like CS 105. There were a lot of assignments... We had to create this thing on my computer, and a girl I was with, both of us were really clueless about computers, and there was really a lack of guidance how to do the assignment, so we were just totally lost a lot of times. They just took hours and hours reviewing in a computer lab, like 6 hours, trying to figure it out, and there was nobody there to help you. You would go to TA's office hours, and then it was a big class, and there was a bunch of people in line, and I was just really frustrated with that a lot.

Participants reported that CS classes were not friendly not only to the first type of newbies, technically less experienced students, but also to the second type of newbies,

experienced students who were just new to CS classes. Participants reported that CS classes often assumed that students had knowledge about technical terms in the CS sense, and did not explain any of them to the newcomers. Chris, who had a lot of computer experiences before coming to college, described the frustration he had when he was first enrolled in a CS class.

> Another thing that really surprised me was, they said that "Okay, when you want to submit your code, you're gonna have to SSH into our server and you're gonna have to connect...." And I was like, "w,w,w,what?" hahaha... As if this was something I do after breakfast. It was completely new to me. The problem wasn't really that I didn't know what to do. The problem was that the things I did know and the things that I didn't know were so sporadic.

It seemed that people in the CS field enjoy having discussions with people who have a similar level of knowledge about computing. Discussions are made among people who already have shared knowledge. When a newbie heard people from the CS field talk, the person felt that the discussion was so over his head. Dave, who indicated that he was engaged in a lot of technical activities, described his feeling that he had in a CS class as being alienated.

> There were four people constantly talking and answering questions in the CS class, and everybody else's face was like "What are you talking about?"

6.1.5 No Consideration for the Use Context of Computing

Another problem that participants pointed to about CS was that CS teaches technologies without considering the use contexts. For example, a business major Rachel reported that she did not have much fun with her experience in a CS class. She learned Excel, VBA and SQL in the class and found them useful, but did not have any inherent interest in those topics. Except for Excel, she did not find the course topics interesting. She explained that she did not like them because she was not able to understand why she needed to learn VBA or SQL, or how she could utilize the technologies for her work.

> I wouldn't say I liked the class, but it was useful just because I learned how to use Excel. But I thought it was really hard, because we did things like VBA, we

> worked a lot on macros, we learned another... I forgot... but it was a searching thing... SQL... I really didn't understand what VBA, or SQL is, at all. So I thought it's very difficult.....I didn't really see how SQL was that helpful... I really don't, even now I don't understand how to use it, or how it's applicable, but I thought when we learned Excel, I thought that was really useful...

Similarly, this lack of consideration of the use contexts in the CS discipline made Chris switch his majors from CS to Philosophy.

> One of the things that I found which is really good about the IT program was that it really focuses more on the interaction between people and computers, instead of just the very low-level programming aspect, which is something that I really missed in the computer science department. There wasn't really anything that computer science can offer me that I was really looking for.

It was obvious that students viewed the value of the CS class in terms of usefulness rather than their interests. Many students responded that the class was useful but they did not enjoy it very much. To a question if he enjoyed the CS 105 class, Brad firmly responded that he did not enjoy it, although it provided useful knowledge.

> Nope! Not at all. I'm not that computer savvy, and also I am not interested in it, so I didn't like it at all. But it helped me. It's something that I had to take, but it's not definitely of interest to me that much.

Taylor, a Finance major also said that his experience in that class was not easy. He took it just because the CS course was required for his major, not because he was interested in it.

> That class [CS 105] was a little more difficult, like the project that we have to do with the macro... I found that that was fine. Then once I put the code that we're writing on the test to find an error or whatever, and once it was written down, it seemed more difficult. It was very Excel-heavy, and you learn all the formulas and you can streamline your work a little faster by running yourself a macro, instead of having to put in all the formulas. We learned how to use the query-based systems, so there are all sorts of different things.

The popularity of this CS course for non-technical majors has many implications about computing education in college. The popularity can be taken as an indication that there are some unidentified needs for some kind of formal computing education opportunity among non CS majors. This CS course is popular because it is the most accessible computing class for non-CS majors. Therefore students' comments on this course provide useful information for their needs for some sort of different education. However, also expressed by the participants was that they did not necessarily enjoy the CS class in spite of the popularity. They felt that CS classes are somewhat useful, but not much. The various reasons that this popular CS class was not satisfactory for the participants indicated that students want another type of computing education.

6.2. A Perceived Gap in College Education

While students expressed that the existing CS program did not satisfy their needs, they also reported that there were some gaps in college education in terms of addressing recent changes and developments related to the increasing implementation of IT.

6.2.1 Less Focus on Current Issues

Participants showed dissatisfaction about college education in that college education generally focuses less on current affairs, but more on historical topics. Instead, they expressed their interests in learning more about current affairs. This concern appeared not only for a small number of fields in the Humanities and Social Sciences, but was common over a wide range of academic disciplines.

Many Humanities fields, such as English, traditionally include mainly historically important subjects in their curriculum. Claire, who considered herself as a very serious English major, said how the curriculum in English is mainly focused on teaching historic materials.

> The second bad thing about the English major is that more modern literature isn't really covered from 1950 and onward. I think almost every English majors are interested in people who are writing in modern times and it's not something that

> really is covered in a traditional English major program I think. I think it really doesn't make sense. I think that it should be a requirement.

Not only the Humanities fields, but also Social Science fields are slow at reflecting recent changes in a society in their curriculum. An Advertising major, Jack, pointed out that recent changes in the advertising field were not reflected in the Advertising curriculum in a timely manner. He expressed his concerns that while the significance of technology-driven advertising platforms is increasing in practice, the new platforms are not being sufficiently addressed in the Advertising classes.

> Coming from an Advertising major, we don't really talk a lot about a lot of technology, which I think it's a kind of shame now, I think that should catch up, because I'm really excited about this minor because so many things like You Tube and Facebook are really really strong advertising platforms. I think the curriculum really needs to catch up and talk about this technology how even advertisements use it to get to reach a lot more people or audience.

The same concern was expressed about the Political Science field as well. Dave, a Political Science major, mentioned that Political Science deals more with historical stuff than the changes that he is viewing right now.

> Courses in my major deal with a whole lot of government stuff, seem more of just history, looking back at the history of government. While in this course (202) I feel like where and what we are studying is going right now. I enjoy that, because it's something that I feel like I am in actually a part of, because I am participating on the Internet which most of these classes talk about, and how information is shared through different chat. I feel like it's not just studying the past.. it's studying now.

Participants pointed out that even within the CS discipline, learning recent technologies were up to individual students. Sarah, who worked as a web master in a student services office, said that she learned all the web skills necessary for web maintenance at her work on the job. She did not have any complaints about it, but her comments indicated that students saw the CS curriculum as theoretical, which focuses on fundamental principles, not on their applications.

Interviewer: Okay… if there's anything new, new knowledge that you obtained from this work, what would you say?

Sarah: I learned ASP from here…

Interviewer: Oh, ASP is not something taught from computer science?

Sarah: No. We're taught C, C++, Java, and we're really expected to learn other things on our own. Once you learned one language, it's easy to learn others, so they teach us those basic three.

Interviewer: So ASP type of things are not taught in the CS department, and you're expected to learn it by yourself if you need…

Sarah: Right. There may be some courses but they are not on the required track and they are not taken by anyone I know, if there are any.

Changes driven by technological innovations are now observed in every sphere of people's life. Students' interests in learning current affairs may not necessarily indicate their interest in learning information technologies. However, insufficient focus on current affairs, many of which are closely related to technological innovations, was perceived as a part of the problem that college programs generally have.

6.2.2 Rigid Boundaries among Existing Disciplinary Programs

In pursuing their IT-related interests, some participants reported that they experienced rigid boundaries among existing disciplinary programs all across the campus, in both more technology-oriented fields and less technology-related fields.

For example, Brad, an Economics major, had enjoyed his first Communications class which he had chosen as an elective class. In the following semester he wanted to find another such Communications course to go further in that topic. However, he found that many classes were open only to the students enrolled in that specific major. As a student from outside of the Communications major, the only class that he could get into was one of the introductory IT classes, which was cross-listed as a Communications course.

I took a great Communications class, Comm 264. A lot of Communications classes are restricted to Communication majors only. I was looking for anything

> in Communications that I can get into with my major, and this one fits in my schedule.

Zachary, a CS major, was taking an IT course that fulfills his general education requirements for Social Sciences. To the interviewer's question that asked if he knew that many Social Science programs offer courses related to information technologies, Zachary pointed out that a rigid barrier existed among disciplines. For example, he pointed out that Social Science classes that dealt with IT were usually offered only at a higher level within a major and students from other majors could not get into those classes.

> Right. but for the most part, to get to anything that even talks about computers, you have to go a way of the line of courses to get up to the point, so... There will be... you have to take five courses to get to anything that really is about computers and I can't do that, I only needed two [introductory IT] courses.

Other engineering students had some complaints that there were not many Social Science courses available, which were devoted to socio-technology issues. For example, some Sociology classes addressed IT related social issues as a part of their curriculum, but it was only a small part of a whole class. All the rest of the classes dealt with issues that were not directly related to IT. As Jake indicated, "most classes touch on the subject a little bit, but there is no class that is entirely devoted to technologies."

> It's something that I wanted to explore about technology and social aspects. There's not a lot of sociology classes about technology and its effects on society.

They wanted some classes that address how their technical expertise situates in social contexts, rather than something totally novel in the discipline of Social Science. Zachary expressed a strong desire to have Social Science courses that are related to computers.

> I saw it [an IT class] on a list of courses that I could take to fill a social sciences requirement for my general eds. I didn't feel like taking psych or any of those types, and I thought IT would be more interesting and more applicable to computer science. So I signed up for 201 and then decided to stick with it for 202.

For him, Psychology is the most typical social science course, which he is not that much interested in. He mentioned "psych" four times in the interview, to contrast it with the kind of social science area he really would be interested in.

> [If there were not IT courses], I would take Psych for social science requirements. [However I didn't like it because] there isn't really anything really into Computer Science. That's why I take these IT courses because these are using computers and talking about them. Yeah, there's no social science course that has anything to do with computer science.

Classes that deal with IT outside of the current computing disciplines are currently dispersed across different disciplines. However, students were willing to take the class across disciplines, as long as the class was available to them. Taylor, a sophomore in Finance, stated that he would be willing to take an information technology class regardless of the field it was from, as long as he would find it useful.

> I think it depends on the situation, like I found a class that I thought might be really interesting, I'll take it regardless of what field it is in. Information technology looks like, it would be interesting to take, or might be a good class to take.

This comment implied that one thing that an IT program would be able to do is providing a central place for many classes on campus which deal with information technologies and putting them into a structure.

6.2.3 A Void in College Education in Terms of Education in IT

As students' awareness that computer-related issues were becoming more and more important grew, participants vaguely felt that there was a niche between technical areas and social areas which was left void in current college education. The finding that CS classes they had tried were not responding to their needs also contributed to this feeling.

They felt that meaning of computing to humans remained void in current college education. Chris commented:

> Throughout high school, I had two main interests. And those were my English courses, and my technology courses. I was really researching ways to combine

> those. Computer Science was great, because it solved one problem. I was able to play with technology. But I wasn't able to write about it. I wasn't able to speak to people about it, or how it influences people. I think that was really... I really wanted to make use of the capability that I had through high school. Again, it's another reason why I found the IT minor and Philosophy to be the ideal system for me because I was able to combine my ability to write and use the communication to describe my education in technology. So the combination of the two really worked out very well.

He specifically pointed out that there is no place that deals with human-computer interaction issues in college.

> But that's not what I wanted to learn. I wanted to learn how people interact with computers, I wanted to learn the other line of reasoning behind computer programs, and I wanted to try and combine human computer interaction with an analysis of how computers affect people. And there was really, that really wasn't an offering in the Computer Science department.....People use technology for some other means. Computers are tools for some other means. Having a computer science degree is good to create and manage those systems. But there is more truth with that. In order to get that extra education, that needs to be LIS aspect to that education.

Participants had recognition that a comprehensive understanding of IT was becoming important not only for themselves, but also for college students in general. They took knowledge of IT as some important knowledge that everybody would have to obtain, regardless of their backgrounds. They felt that knowledge of IT was important practical knowledge that everybody should have, because they felt that many things were already computer-based and the prospect that more and more things would be so. Tom did not show much interest in learning IT for himself, but stated that every student on campus should have knowledge about IT.

> So I mean, in theory, every student should have this kind of information because it's gonna be a computer-based world. Pretty much already is.

Participants pointed out that most areas of study in college had some relation to the development of IT. Therefore, interviewees commented that it is important for college students to understand how their own fields are related to IT. Jack pointed out that IT was being actively used even in classes in the Humanities.

> So many of the Humanities classes outside of the minor are using technology now. I think it's really important to understand how technology would relate into those fields. I don't think that there is necessarily a particular student. I know our IT class now, there is an English major, a History major, I'm an Advertising major, there is a business major, and those are undergrads.

Therefore, they pointed out the knowledge of IT could be beneficial to various student groups on campus. Emily, a Psychology major, pointed out the benefits that the humanities students would get by acquiring technical knowledge and also the benefits that the Computer Science majors would get by acquiring knowledge of user issues of computers. She also specifically mentioned what kind of benefits that other majors could get from IT education.

> I can't think of any major that it won't apply to. Even if you're in computer science, you could see the soft side of computer science, having things to be more people-friendly. If you're in humanities, you can learn more technical stuff.....CS majors can be more people-friendly computer science majors, not just the stereotyped CS majors. Then if you're in humanities you can learn more technical aspects. So it's a kind of a nice medium between the techy side and a totally humanities side..... If you're a pre-law, or a lawyer, these skills would be useful because it would help you be able to search for information and law cases better....We learned about knowledge management and organizational structure, so if you're going into business field it would be useful.. If you're an Anthropology major, you can take classes in Museum informatics, and learn about how museums work...

Kelly pointed out the utility of acquiring skills and knowledge of IT especially in terms of students' future lives after finishing their college education.

> I can't really pinpoint it [IT education] to any one major, because everyone is going to be using computers in their life. I think it's really essential to any person, especially in the humanities, because they're gonna be sitting around a board meeting talking about what program to buy, how they should organize information, that sort of things..... That's a lot of what it is that learning how to incorporate technology and talk about and vocalize it, and realize it is so pervasive. English majors, CS majors, and nursing majors... One of my friends, she went to human resources right after she's done here. I think if you're looking to supplement your degree, then absolutely everybody needs this kind of education.

Therefore, some students even thought that understanding of IT is new knowledge that everybody should acquire, and should be "a vital part of general education," as Chris put it:

> A grounding in information technology I believe is it's a necessity for anybody. I would definitely say understanding of these different fields, the impact of information technology on people as a whole, is a vital part of general education.

As the awareness that IT is an important topic was growing, participants felt that this was something that college education should deal with. They did have some sort of sense that there might be some education program focused on IT, which would be different from the traditional CS program. They felt so even without explicit knowledge about the existence of the IT program. For example, Brad did not know that the IT program was actually available on campus, but had some sense that such a program might exist.

> Interviewer: Did you know that there is an IT minor on campus?
>
> Brad: I guess I would've.... I don't know explicitly, but I figured that there would be...IT isn't something that I'm extremely interested in, so I wouldn't have considered it, I wouldn't looked into finding whether there was, but yeah, I guess I didn't. Not explicitly, but I would have it was something I was interested in, I would have figured that you can get an IT minor.

Interviewer: So you had this feeling that there is something like an IT minor on campus…

Brad: Yes, feeling. That's a good way to put it. I figured it was there, but I didn't actually know.

Students' perceived limitations of college education reported in this section indicate that students feel that there is a niche in college education in terms of dealing with the recent developments of IT.

6.3. Summary

This chapter examined problems that college students feel with regard to the traditional computing education programs and college education in general. The existing structure of computing education in colleges does not satisfy students' needs for some sort of computing education. Computer science (CS) is a prototype of the existing computing education. However, students' perception about existing CS education was not very positive. Students expect the existing Computer Science program to offer something to fulfill their needs of creating digital applications on their own and getting a comprehensive understanding of IT, but the CS discipline has its own agenda and does not respond to the increasing needs of college students who are not CS majors.

Not surprisingly, participants felt that CS is very difficult, and that one should have special talents and interests in the essential math principles that are the foundations of CS principles to study in that field.

Although participants do understand that taking classes in computers or IT does not necessarily lead to an IT career, negative perceptions about IT professionals' work significantly influence their perceptions of computing education.

It seems that many students feel that there is some kind of void in current college education in terms of dealing with many important current changes driven by the IT innovations. IT has been something beyond the current educational structure and is an area that cannot be defined with the existing units in higher education. Students move

their attention to the IT classes after realizing those problems of CS classes and the gaps of college education in dealing with IT related issues.

7. STUDENTS' INTERESTS AND MOTIVATIONS IN INFORMATION TECHNOLOGY EDUCATION

The reasons that students would seek formal education in IT were explored in the previous chapters. In spite of their intensive and competent use of IT in everyday life, many participants indicated that they would take a formal IT education opportunity because they considered IT knowledge and skills increasingly important and therefore felt that they should acquire the knowledge and skills before graduating from college. Also found in the previous chapters was that the existing educational structure in college, which includes several different computer learning opportunities, such as the traditional computing degree programs and the training opportunities offered through the campus IT support unit, does not properly address students' various interests in IT education. While describing their past experiences of dealing with IT and feelings about existing IT learning opportunities in college, participants expressed their various interests in and motivations for IT education. How are these unique interests and motivations about the field of IT laid out?

7.1. Types of Interests: Technical and Social

Findings from the interviews suggest that students' interests were dispersed around two poles: Obtaining practical computer skills and learning social implications of IT. The most characteristic about these interests in IT was that many students had mixed interests.

7.1.1 Acquiring Practical Hands-on Technical Skills

Several participants expressed that their main reasons for pursuing IT education was acquiring practical hands-on computer skills. Some participants' interests introduced earlier at the beginning of Chapter 4 were good examples of those strong interests in acquiring practical skills. For Brad, a senior in Economics, the number one interest in IT education was acquiring sufficient Excel skills to prepare for his future job in the commercial banking field. He also wanted to gain some web design skills as he had a vague feeling that web design skills were becoming important to anyone. For Janet, a

senior in English, the top interest was acquiring desktop publishing skills as she was pursuing a job in the publishing field.

Many participants who expressed a strong interest in obtaining technical skills were non-technological majors. These participants indicated that they wanted to learn how to "program." However, it should be noted that the term "programming" that they used did not correspond to the programming that is the focus of the CS curriculum. As some students commented, that kind of programming was just "too much" for them. Janet was quite interested in learning how to make usable computer applications, but thought that doing programming in the CS sense would take her too much away from her major area and the professional area that she was preparing for.

> I don't really think I necessarily want to get into programming, because I think that's bearing a little too much away from what I want to go into, but I would like to learn a lot more about web design and different web scripts, because one thing I could go into for publishing is Web publishing. There's also a lot of magazines, and I think I would have a better time getting a job like that, if I was really comfortable, writing all the content, putting it up there on the internet, and making a website. I would just like to broaden knowledge of that, I think.

The "programming" often indicated web design skills. Participants often talked about a need to learn "programming," which often meant a limited range of technical skills necessary to create web pages. Due to the fact that web design has become a relevant technical skill for many people, participants felt that they needed to obtain computer knowledge and skills to be able to set up web sites by themselves. This feeling was typical among participants, including those who reported that they were not very competent in dealing with IT. Brad, who showed least inherent interest in learning technical skills among all the participants, expressed his interest in learning some Web technologies to create web pages. As described in Chapter 4, Brad had not been fond of dealing with technological things in everyday life. However, as he felt web design skills were some basic skills that were expected of anyone these days, he believed it would be a valuable skill that he would need to acquire before graduating from college.

> The one thing I wish I come out of college knowing about is a little bit more about how to set up a basic web site. That would be great. I think that more classes should include that. I did a technical writing course that involved wikepedia [Wiki] posting but that's different. One functional knowledge that I wish I had was just setting up a basic web site and learning a bit of HTML programming just enough to get by. Because I am sure that that will be advantageous for later on...

Many times the web design skills were expressed as "HTML programming" by the participants. Writing HTML is not exactly a programming language. Rather, it is one of the markup methods used to represent digital texts on computers. However, to many non-technical majors, writing HTML was one representative type of programming. It is a different level of computer use from their ordinary activities on a computer, such as entering data into a system or using popular office software applications. Students felt that this level of "programming" was not being currently taught in college in spite of its importance. As one English major, Claire, pointed out:

> There are a lot of things that I don't know, which would be probably helpful for different jobs... like Dreamweaver for example... and just basic things that I don't really use. Web page design, that's the other thing about the IT classes for the minor. I don't know anything about web design... I mean, I took a class "Intro to Interface Design," but creating HTML, or anything like that I don't know how to do it. I talked to a lot of other people in the minor, I think that's a real shortcoming. Because they are all about social implications of technology. That's good to know. But it would also be helpful to learn some basic things about web design...

The interest of Dave, a Political Science major, in learning technical skills also showed that the technical skills that students desired to obtain were different from the skills taught in the traditional computing disciplines. Dave emphasized that he really liked to be engaged in technical activities, such as making DVDs or figuring out features of popular software applications. However, he firmly asserted that he did not want to do programming. Not necessarily requiring students to learn programming skills was what

was the most appealing to him about the IT program. He felt that this aspect of the IT program, dealing with technical skill while not requiring students to learn programming, went well with his deeply rooted interests in applying computer technologies to his various activities.

> When I was browsing for what minor to pick, I saw this one, and I thought, I like computers, but I do not like programming, so I can't be like a computer science major, but I enjoy the Internet, and I enjoy the capability so the professor told me to pick this one. I know how to, by definition, I am a hacker because I just self-taught computers while my parents were on a computer, I taught myself how to use it. I had experiences of messing around and learning programs... I was educated in high school how to deal with Microsoft office, so I have been familiar with that, and I was able to solve problems, like troubleshoot things... Photoshop. While I was playing around with it, I figured out the functions, so... I enjoyed the technical aspect. That's a big part of why I picked the IT minor.

IT-related majors were also interested in obtaining technical hands-on skills in spite that they already had obtained enough technical expertise through their academic training. These students perceived that the technical skills taught in IT classes were different from those skills normally taught in their major fields in that the skills taught in the IT program had more immediate practical value than the skills taught in their major fields. A comment from Eric, an MIS major, showed his desire to acquire practical skills instead of theoretical knowledge of computing which he felt was a focus of MIS.

> At least the two IT classes that I've taken in this minor are much more hands-on. Whereas the database management class [in the MIS field] and the other classes that I've seen so far have been primarily looking at the theory of it, like the underlying research that has gone into the entire history of database management. So IT classes are the only ones where I actually looked at programming languages and programs on that level.....I was disappointed to see that it [MIS] is almost entirely theoretical and maybe 20% at most is practical hands-on sort of things. It seems to be the case that if you want that sort of things you should sign up to be a computer science major, which I wasn't aware of. It is a lot more

> theoretical than I expected. I signed up for a class like project management, and found out that there wasn't any hands-on practical works, so I dropped the class. As far as I know, there's only one course that really delves into programming within the MIS major. I was disappointed with that.

Technological majors found the technical activities required from the IT classes to be more useful than the knowledge obtained from their majors. For example, Zachary, a CS major, reported that he enjoyed the class project of creating a web site in an IT class, which was assigned as a group project. The reason that he especially enjoyed that class project was not that he obtained additional technical knowledge to his prior technical expertise, but that he had an opportunity to work on the project with other students from different backgrounds. He indicated that he enjoyed the opportunity of working on practical applications upon which he could collaborate with other people.

> The project in the IT class at the end, making web pages, was fun for me. It's actually making a website, instead of doing markups. We actually had working web sites that were hosted on my computer. That was fun.

As shown up to this point, both non-IT related majors and IT-related majors were interested in obtaining practical technical skills. They commonly indicated that they had obtained some technical skills that were different from the skills of the typical computing education curricula.

One reason that non-IT related majors wanted to obtain practical technical skills was their desire to be able to create digital artifacts by themselves, not just remaining as a user of already made technical products. Some participants believed that they needed to know something more than how to use existing technologies. These students believed that those abilities to create their own applications on a computer had much more value than simply being able to use popular consumer technologies like Microsoft Word or Excel. Being able to use ready-made computer applications and services was not taken as a valuable ability.

Kelly, a Media Studies major, addressed that an area of IT where she hoped to improve was abilities to make something on a computer on her own. She was able to make good use of many ready-made technologies on the Web as a heavy user of those technologies,

but wanted to be able to do more than simply using these applications. She regretted that she did not have the skills to create things on her own.

> I have my own blog, but all I do is inputting information into a computer. I don't know how to write HTML or anything more advanced...

As skills of making web pages were taken as the fundamental computer skills that became relevant to everybody, some introductory CS classes as discussed in Chapter 6, started to include web design as a part of their curriculum. However, participants were not satisfied with those classes' approaches of teaching Web technologies, because they thought that the classes taught just how to convert documents made with a popular word processor into a webpage, instead of teaching the technical skills of creating web pages on their own. Lisa, an English major, said that she was not satisfied with her experience in that class because all she did in that class was making a web page using Microsoft Word and converting it into a webpage. She did not take it as a true ability of creating web pages. Instead of getting an aid with the popular technologies, students desired to obtain the technical skills necessary to create digital artifacts on their own.

> Yeah, but they did it through MS word. Instead of doing "Save as a document," you did "Save as a webpage," and then you just upload that to netfiles. It wasn't complicated... I know that some people don't even consider it as a "real web page" so it wasn't that technical very much.

As shown above, students who wanted to be more competent in dealing with IT thought that they would have to obtain the abilities to create computer applications on their own to become truly competent in utilizing IT. It seemed that the desire to create digital artifacts by themselves grew as they became able to deal with computers more adeptly, as the desire to create things by themselves was more strongly expressed by those participants who believed that they had at least an intermediate level of IT competency. Emily, a Psychology major, earlier rated her IT competency higher than her peers, on the basis that she had "more IT skills than most people who aren't engineers." She described her excitement when she saw the things she made in an introductory CS class actually worked and could be used.

> It [CS 105] was challenging but I liked it, because I was accomplishing something. It was nice to be able to, it was kind of cool to build a program that actually did something, instead of a static things. We built things that actually ran and made web pages and actually ran queries. That was kind of cool.

Participants' desire to be able to make digital artifacts on their own indicated that they valued creativity in designing their own stuff to realize their own ideas. One factor that made participants to take such creative ability as valuable was peer recognition. When working with their peers, students considered that contribution to their class work in the technical capacity of creating outputs was more visible and well-acknowledgeable to their peers. This value was expressed most strongly in a context of working on a group project. Especially when participants worked in a group in an IT class, they considered that significant contribution to a group project was made by those who had programming skills and hence directly contributed to create an output. As Jenna said:

> In class, whenever I am doing a group project, I'd like to know more about computers and contribute more to the efforts more. And feel like I am contributing something to the group more than, like my research skills or other skills that I have, I'd like to be contributing in that way.

Valuing creative ability was also important for their practical considerations of preparing for their future careers as well. From what they heard sporadically about changing workforce qualifications, students considered that creativity of conceptualizing their own projects and carrying them out on their own schedule was one of the most desired qualifications from future workplaces. Sarah, a CS major, told me a story that she had heard about the relationship between performance at school work and creativity. Her story implied that students desire to develop creativity for its future utility.

> I remembered looking at the Microsoft job board, they were talking about GPA. And the recruiter was saying that he has noticed that people who get above 3.8 tend to do really badly in the work world. Because in CS, getting a good grade isn't really really hard to do, and those people tend not to have much experience. And they tend to be a lot less creative, because they will be stuck in the way I was taught how it is.

Studies about future workplaces predict that abilities to conceive a new project and perform them on workers' own agenda would be considered more valuable than the abilities to carry out assigned tasks (e.g., Pink, 2002; Gray, 2001). Students' statements indicated that they were at least vaguely feeling the changing requirements from their future workplaces if not clearly aware what those are. The interview narratives suggested that students desire to learn practical skills because they value creative abilities in their social relationships and for their future lives. Participants felt that being able to create something on a computer is something that would enable them to make visible contribution among their peers. Sometimes students considered the creative ability as a practical qualification that was greatly sought for their future lives.

7.1.2 Understanding Social Implications of IT

Another type of students' interests was learning about the social ramifications of implementing technologies. Participants who had this type of interest believed that there must be a different approach of studying computers other than programming. Janet pointed out that programming was only one part of knowledge about computers and there was significance in studying IT from another perspective.

> I heard some awful stories from my friends. I have friends who've taken CS courses, and they just sound awful. I am not as into programming as to learn programming. I guess it depends on what aspects of computers you want to know how they work. If you really want to know how the insides of each program work, I guess that's a good way to do it.

Participants who had this type of interest said that they chose to take an IT class because of their interest in learning how technologies affect people, rather than their interests in acquiring specific technical skills. For them, the contexts in which computers were being utilized were more interesting than computers as technologies. As Kate stated:

> [Comparing to CS], IT classes are all different. They definitely usually focus more on the theories of computers instead of actual practical applications of computers. So a lot of times I think it's probably more interesting to computer science majors, because so often they're doing actual computing, but oftentimes

> we talk about computing and how it fits in society and people's life, which is kind of the other aspect of it.

It was evident that these students were more interested in learning about the various social contexts of computer implementation and use. Jenna said:

> I would think that these IT courses are more general and related to the culture and everyday world, as opposed to just the computer....My interest is not much relating computers to technical stuff, but more relating them to culture and current events, and how the computers have evolved...

To this type of students, talking about technologies without going deeply into the technical details was why the IT program was appealing. Jenna had expressed her fear about taking technical classes in the IT program as she was not very experienced with information technologies, but found some IT classes doable because these classes viewed computers in another way.

> All I really thought about it was, I didn't really think it would be too technical..... so I was looking forward to looking at computers in another way besides just the hardware.

Participants' comments indicated that students who did not like to use technologies or were not good at dealing with technologies were also interested in learning about social implications of computers, such as the impacts of technologies on people's lives.

Participants liked the socially-oriented IT classes because those classes dealt with many current issues that were pertinent to their everyday life. It was consistent with the finding reported in Chapter 6, that students were regretful that most college classes do not sufficiently deal with current affairs. Dave mentioned the knowledge of how the technologies affect the society would be what he was getting from the IT program. He was interested in the IT program because many IT classes dealt with current affairs that were very relevant to his current life.

> My major deals with a whole lot of government stuff, seems more of just history, looking back up the history of government, while in this course [an IT class], I feel like what we are studying is going on right now. I enjoy that, because it's

> something that I feel like I am in actually a part of, because I am participating on the Internet which mostly these classes talk about, and how information is shared through different chat, for instance, the cell phone activity that we're doing in 202, or the diary I fill out, that's a cool study. I feel like it's not just studying the past, [rather than] studying now.

As the IT classes dealt with the things relevant to current affairs that they were well aware of, students became more interested in the social implications of IT. Dave described his excitement when he ran into a topic that he can relate to.

> Yeah, she [instructor of an IT class] showed us the popular videos... that was like the stuff that I do in my free time. In my free time, I'll go to e-bombs world, check out some funny videos, like break.com. We basically went over them, that's why I like this. "Hey, I do this some free time. I am learning about this in college. This is great." Those things are what I really liked about the class.

The IT classes that dealt with social implications appealed to him because he could relate the class discussion to his prior knowledge about IT, which he had obtained through his everyday life activities.

> I felt familiar with the topics and terms, definitely. I feel like whenever she is talking about blogs, or whenever they are talking about anything technology-related that I know about, I can definitely relate... I was like "Okay, he was talking about computing, I know what computing is about, when he was talking about editing, I know what he's talking about." I think experience helps, experience really helps with this minor, my experience with computers...

Often, giving clearer ideas about the IT-related topics that students had vague grasp about in everyday life was pointed out as the value of learning social implications of IT. Dave said he gained clearer ideas about many of the social issues, such as information security, usability, online relationship, or IT and work, from the IT classes.

> I had vague grasp on most of them, but yeah, as far as an analysis of each individual topic, no, I definitely gained some insight on them because of taking these classes.

Matt, a Computer Engineering major, also said that IT classes were valuable in that they made his vague knowledge of the social significance of IT more apparent.

> I think I knew before taking the class I knew a little bit about everything. I knew that there were online relationships where people had met online, met in real life, either liked each other or didn't like each other, that type of stuff. I knew the political landscapes, all the bugging changed elections and how people perceive everything else like that. But it just gave me much more in-depth view of all the results and effects of those communications on society.....I knew about them but I didn't know in-depth about them, which is what I got out of this course.

Matt also commented that social implications of IT were interesting to him mainly because he could get a sense of how the things he worked on with his Computer Engineering major might affect society.

> I was just looking through the general eds, and the title caught my eye. "Communication and information technology or something information technology affects something like that," I thought that it would be good to know how the stuff that I am working with affects society..... Discussion about different technologies, how things have changed or enabled the world, either brought us closely together, that type of stuff. Where we might be going, or how we adapt to where we were at.

Also found from students' remarks was that the range of technologies became wider when talking about social implications. While their interests in acquiring hands-on computer skills were discussed mainly in relation to personal computers, social implications were being discussed in relation to more diverse technologies, such as social networking technologies, consumer IT devices, even a broad communications network upon which different media were connected. As Matt above was talking about his interests in discussing broad social implications of IT, it can be easily seen that he brought the broad communication infrastructure built on computer networks into his discussion, rather than just personal computers. Rachel, who showed a strong interest in learning about social implications, also stated:

> I've always liked learning about technologies and like how people use it and how it affects people, I don't necessarily like using technology itself. I took a class last semester... It was COMM 101 and it was a lot about TV, Internet, and different types of media and how they affect society and different groups and different stereotypes... I thought it was interesting. So I thought that this minor is fairly similar to that.

The interview data showed that students' interests in learning the social sides of IT were quite strong. These interests were clearly differentiated from participants' interests in learning technical skills.

7.1.3 Mixed Interests: "How Humans and Computers Interact"

One characteristic of students' interests in IT education was that a lot of their interests were a mix of the technical issues and the social issues. A lot of the practical computer skills that many participants desired involved user considerations. Many participants focused on users and usability issues of computer applications as a rising concern. User considerations were most obvious in their desire to learn about web design skills. The fact that many people are using web sites these days made students feel that usability of information systems is an important topic. Jack, an Advertising major, reported that he became interested in usability because so many people were using websites these days.

> That class was very helpful, because I think a lot of things are either on the web right now or going in that direction. I think usability is really important because I've been on so many websites, not being able to find a button or not knowing where to click, and that's one of the big issues, it just does not allow people design for usability.

Some students were very critical about the insufficient usability concerns frequently observed in many existing websites. Abby, a Journalism major, pointed out that many people working with the web are not actually aware that their web sites are not very usable.

> I've told with a bunch of people at the [name of the school newspaper where she was working], who are interested in Java or putting things on the web,

> maintaining the web pages, about the interface of it, like how horrible it is, but there are interface classes but they have no idea. They've never heard about it.

Such awareness of the importance of usability often led students who had not had formal training in CS to consider obtaining computer skills to design more user-friendly interfaces by themselves.

User considerations were apparent in the participants' hope to be able to create not just simple and static web pages, but web pages that were interactive enough to engage users. Lucy, a History major, strongly wished to be able to make a more interactive working web page by herself:

> He [a classmate in an IT class] has talked about different things that he has done on the web. I wish I'd be better at building more interactive web pages. I can make basic static web pages, but I wish I was better at building more interactive ones, because I think that's really interesting and useful for my future, getting a job, and stuff like that.

Therefore, she considered her group project experience in one of the IT classes to be very meaningful, because she and her project group could make something that would be usable by the general people who are interested in the Humanities.

> Our project is to make, we're supposed to build a web site that is like a humanities project. So I think that sort of is nice, because it covers everything that we're supposed to know in the class using the technical side and combining it with each of humanities background, make something that would be usable by the general public, interested in humanities...

Lucy's interest in IT focused on people's use of IT, as opposed to the technology itself. She stated that the real significance of IT was "what it can be used for," and "what you can do it with technology," contrasting it to "streams of codes."

> ... beyond just all these streams of codes, what is it used for, and how do you use it, I think it gives you a sort of more application field of things, like what it can be used for, or what you can do it with technology, instead of simply what is technology.

These students were excited by the fact that there was a way in which they could create more user-friendly applications without needing to learn the complicated computing principles. Emily, a Psychology major, felt that she was pretty much experienced in IT, and pretty good as a user. She did not have any formal programming background, but felt that she had more technical expertise that her similar peers. She wanted to learn how to design computer applications that ordinary users like her would use. She was excited when she learned that she can design interactive computer applications without needing to know any complicated technologies, through a method she called "low-fi design."

> I am very interested in how humans and systems interact. Human usability stuff. That's also very interesting to me.... I was taking X [name of an instructor in an IT class]'s class, "programming web mesh-ups" last semester, and he [an instructor of another IT class] came in one day and led the class, and he was talking about low-fi design, and I thought it was cool.

Being a Psychology major, Emily believed that she had deeper understanding of people than other students. Taking that understanding along with her technical expertise which was "better than her similar peers," she believed that she was in a good position to contribute to building more "people-friendly" interfaces.

> Even if you're in Computer Science, you could see the soft side of computer science, having things to be more people-friendly. I've noticed that a handful computer science majors in this minor... they are more interested in user design, and they are more people friendly computer science major, not just the stereotyped CS major.

Participants who were interested in designing user-friendly applications often had at least an intermediate level IT competency. It seemed that their enhanced IT competency made them take the user-related topics like usability of interfaces as relevant for them to address. They might not be technically competent enough to design digital applications from scratch, but had the level of technical understanding to improve existing applications or to make suggestions to improve existing user interfaces. This advanced level of computer expertise made them desire to contribute to enhancing existing user interfaces. As Lucy stated:

> I feel like I might be a little bit better at some stuff than other people, but then that makes me wish I know more, makes me aspire to learn more about it.

What they wanted to build from their baseline competency was not fundamental programming skills in the CS sense, but skills to build user-friendly interfaces. Overall, the increased interests in Human Computer Interaction went hand in hand with the general increase of students' IT competency level.

Technological majors' interest in IT focused on immediate interaction between technologies and users, as opposed to the back-end of technologies. They also felt that the use issues were significant and different from the pure technical issues they typically learn from their major. Their interests did not go into the theoretical/technical details of technologies that were addressed in their majors. Their interests did not reach too far to the other direction of discussing social ramifications of IT either.

> Not only what it [technology] is, but how it works, and how I can grab a hold of it, twist it, and change it to suit my needs.

Many technological majors pointed out that these user-focused issues had not been fully appreciated in their own fields. Sarah, a Computer Science major, pointed out that many CS students were more interested in learning the "back end" technologies, which does not involve much consideration of human users. She identified herself as one of the few students in her field, who were more interested in the "front end," where immediate interactions with human users occur.

Nathan, a Computer Engineering major, pointed out that his major field did not teach anything about how users would use the products that they make. He criticized that the engineering fields teach how to develop the back-end technologies and how to get everything to work, but that these things were not necessarily usable. He pointed out that engineers make many types of utilities, but not necessarily considering users' perspectives. He brought up the necessity of learning about usability of computers, however, anticipating that his future work in that area would involve a lot of user interface issues.

> My job [as a computer engineer] entails a lot of user interface type of work. I think it's a very useful skill to have. I really don't have time anymore in engineering.... Engineering is definitely more of... Engineering teaches how to develop back-end, how to get everything working, not necessarily usable..... The biggest difference [between Computer Engineering and IT] is the perspective it takes, the approach to looking at all this information technology resources. So it's not an understanding of how they work. It's an understanding of how they're used, which is a very different approach.

These Human-Computer Interaction (HCI) components made these technological majors find the technical activities in an IT class were more useful and more immediately applicable than those in their major field. For example, Nathan stated,

> I liked the Web technologies class more [than 201], because it was more fun, more interesting to me, and more of what I like to do. More interaction, more hands-on stuff.

The other type of students' interests, interests in social implications of IT, also included a lot of user considerations. Participants who showed more interests in discussing social implications because of their lack of enough technical background also said that they wanted to understand "how people and technologies interact." These students tended to use the term HCI more broadly than IT-related majors. The term HCI has denoted a specific field within software development, which focuses on designing user-friendly interfaces. For example, the CS community has considered HCI as a specific sub-field within CS, which is designated to design systems to be more friendly to end users, as the ACM SIGCHI conceived it as "designing, evaluating and implementing interactive computing systems for human use." (e.g., Hewett, et al., 1992) In contrast, participants often used the term HCI more broadly. This "how humans and computers interact" in this study has the traditional concerns of HCI of designing more user-friendly interfaces at the core but also reaches to other broader concerns like social implications of technologies. Chris stated:

> I think those who are interested in the same kind of computing as I am, computing as interaction, less than computing as a goal and an end itself. If people are

> interested in studying how people interact with computers, how computers shape their lives, IT is an ideal place to investigate some of that knowledge.

These students' view of the "HCI" had more social tone than the typical HCI did. For students, HCI was not necessarily a technical term that indicates issues related to designing user-friendly interfaces, but was more about people's broad interaction with technologies. For example, Chris broadly framed the field of IT as "Philosophy of Information Technology" on his own.

> I would really classify IT as "philosophy of information technology," because we're not learning in IT how to build computers necessarily. We're not learning in IT how the processors work, or how packets are sent. We're learning how people interact with computers, and how they consider computers to operate in their lives, and how we can improve and teach people about these different computer systems. In my philosophy courses, I am continuously talking about how people relate to each other, how people relate to their surroundings, and how people relate to roles around them. What IT is, it seems to me, just a very specific set of that sort of mind set, except that in IT, the main focus is on people's relation to information technology.

While the "how humans and computers interact" indicated a broader area than the typical HCI, its extent was limited by topics that have immediate implications to their uses. This immediacy differentiated this "extended HCI" from the broad sociological discussions of the impacts of the IT development on people's life. It focused more on the smaller scale user interactions with technologies than the broad impacts of IT at a societal level. For example, Lauren, a Sociology major, commented that IT courses were different from Sociology courses in that the former focus more on individual level issues while the latter deals with more societal level impacts of implementing technologies.

> A lot of Sociology classes discussed larger social structures and institutions, and what 202 did was different. She [an instructor of an IT class] looked at small things within our lives, things that look insignificant, and she kind of broke those down as meaningful... Specifically I enjoyed how she got into things like Facebook, and cell phones, everyday technology, which we just don't talk about

> in other classes. It was interesting because it's about what us students do and use all the time.

From the above observations, it can be concluded that the users and usability area is where the interests in the technical and the social meet. Many participants who expressed interests in obtaining technical skills were interested in designing user-friendly computer interfaces. Their focus was more on acquiring practical skills, than learning theoretical principles of technologies. Those who expressed interest in learning about social issues were interested in understanding the user contexts of technologies. Their focus was more on users and their immediate user contexts, than on macro-level societal variables such as social classes, race and gender, and marriage.

One important implication suggested by the mixed interests is that now some level of interest in IT education may be common across a wide range of students, either technical or non-technical. Some non-technical students thought that they could discuss "how humans and computers interact," even though they did not have enough technical skills. Jenna was one of the participants who thought this way:

> Because I am not really very experienced with computers, I asked the IT advisor what classes would be less technical, and more underlines of computers and culture, human interactions with computers...

7.1.4 Shifting Interests: Technical to Social, Social to Technical

Up to this point, it was shown that students' interests in IT education were dispersed around two poles: learning practical technical skills and learning social implications. A frequently observed pattern was participants' strong preference either for technical topics or for social topics in the IT program. While some students asserted that they were equally interested in learning web design/programming skills and learning social implications of IT, students who were interested in acquiring practical web-related skills showed less desire for dealing with social implications. In contrast, those who expressed a stronger interest in social implications tended to express a low level interest in acquiring technical skills. While these students did not have much interest in learning technical skills, they were deeply interested in learning the impacts of applying advanced computer technologies on humans' life. Because of the preference, it seemed that the

interest in technical aspects and social aspects are negatively correlated. However, looking more in-depth, it is not such a simple negative correlation. One significant finding was that students' interests often shifted from technical to social, or vice versa, as a result of having the IT education opportunity.

Participants who showed a strong preference for technical topics either had high technical skills or lacked technical skills. The former students thought that the practical technical skills taught in IT classes were very new to them, and realized that the value of obtaining those practical skills would be very high. Therefore these students just were not paying enough attention to the social issues. The latter students lacked technical competency. These students felt that acquiring technical competency to make up for their technical deficiency was their priority. This urgent desire to acquire technical skills made them more focus on technical classes and less on social classes.

Social implications initially attracted fewer students than the practical hands-on skills did. A large number of participants came to the IT classes to acquire technical skills. However, the interview data showed that sometimes interests in social implication of IT arise as a result of taking one or more technical classes in the IT program. For example, one computer geek, Andy, who participated in this study expected to deal with mostly technical skills from the IT program. He said that he wanted to learn technical skills which were markedly different from his major Political Science. Later he found that his study in IT was not only supplementary to his major, but also was complementary, in that IT classes had deepened his knowledge of some issues in Political Science.

> I came in expecting maybe more of a technical snap, more technology of information. But I found that, we're more or less learning about the internet, what it means to people, what we can accomplish with it, and who uses it. Also, it would appear to, if you took, like a sociology class, it's geared toward information proliferation and the technologies they use, IT, this is what you get... So, I wasn't really expecting anything like that when I came in. So I tend to work more with the technology aspect, and have enjoyed that more in the minor, than researching how long people spend looking at certain sites, or what a typical geek or a nerd might be.

Most technological majors interviewed for this study chose the socially oriented IT classes for other reasons, such as to fulfill their general education requirements. Then they developed interests in the "how humans and computers interact" from there. These interests developed while taking IT classes, as a result of being exposed to the various issues that connect to technologies and society. In this way, students who had not initially been aware of various social implications also came to appreciate social implications.

Some non-technological majors who were initially attracted by social topics of IT generally tended to have low technical expertise. These people tended to emphasize their indifference to acquiring technical skills. However, they had this preference for social classes not because of their indifference to technical skills, but because of their lack of minimum technical background to learn the hands-on technical skills. Because of their lack of confidence in acquiring technical skills, they tended to look more at social classes that did not require high technical expertise.

Actually these students tried to approach IT issues with a method that was familiar to themselves, like discussing and analyzing the social implications of technologies. One English major, Lisa, provided an interesting viewpoint for the IT curriculum. She argued that her major English and the IT minor share some common features. She argued that they both are about analyzing. As a non-technical major, she earlier indicated that she had fear about dealing with technical things in class. However, as she found out that the IT program was not all about programming, she thought that there was some parallel between her major and the IT minor. She came to feel more familiar with the IT field since she has discovered the commonalities.

> I suppose that they [English and IT minor] do fit off each other because the English major is all about analyzing things, breaking things down, and deconstructing things, and I think that's what the minor looks for to some degree. Both have very much focus on critical theories... So I think that whereas the English major would focus on text a lot, like analyzing texts, the IT minor looks at analyzing objects, and technologies, so you're analyzing cell phone use, the use of computers, something like that. So I think it broadens my horizons of it ...

Rachel, who showed great interest in learning social implications of IT, expressed her fear of doing technical hands-on things. She found that it's more about reading and analyzing the impacts of computers on society which she did not have to be afraid of.

> My biggest fear for this minor was that we would have very hands-on computer class, and I was really scared that that's what it would be, and I wouldn't know what to do. But it is not... it's a lot more about reading and analyzing, how computers affect society... I think it would be of more interest to someone who doesn't really know how to use computers very well...

These comments showed that even students who lacked technical skills also felt that IT education was important. They tried to make themselves familiarized with technical issues with a way that was familiar to them. Brad's comments imply that there may be a group of students who are away from the IT studies just because they feel that they are not technically competent enough. If they knew the study of IT was not all about doing technical things, they would be willing to take the IT education opportunity and get the benefits of it.

> I think you'd better off, if you try to get students to enroll, you'd better selling it as, from the social side... That's what would interest me or my peer group.

From these findings, it seems that the significance of the IT program is providing an intermediate field where students can explore various issues in IT. IT program introduces social implications of IT to students who want to obtain practical technical skills. The IT program also provides opportunities to become familiar with technical issues to students initially attracted by the social implications of IT.

7.2. Types of Motivations for Pursuing IT Education: Passion and Practicality

Students' motivations for pursuing IT education also were distributed over different factors. Some participants emphasized that they took IT classes because they had inherent interests in IT. These students denied any practical interests that might have been involved in their intention to pursue IT education. Meanwhile, other participants emphasized that they took IT classes mostly because of some necessity, not because of

any kinds of interests. However, those students who talked about either passion or practicality were relatively few. Instead, the majority of the participants indicated that they had a blend of practical considerations and interests in IT. Students' mixed motivations were often more strongly geared toward their practical considerations. This pattern signaled that practical considerations as well as interests in the subject matters are important in understanding students' interests in the field of IT.

7.2.1 Passion: Inherent Interests

Some participants sought IT education due to their inherent interests in computer technologies. This group included typical computer geeks who learned programming all by themselves and were engaged in activities of making computer applications or building computers just for fun. Also included were those students who just loved working with computers, if not programming or other fundamental programming principles. Some other participants expressed strong interests in discussing social impacts of IT. As IT has become increasingly relevant to students' everyday experiences, just discussing the impacts was interesting to these students. In common, these participants did not care about, or even denied, any possible practical benefits they would obtain from an IT class. Instead, they emphasized their pure interests.

Computer geeks are often deeply engaged in various technical activities from no other reason than they are inherently attracted to working with computers. Many Internet researchers have acknowledged the significant contributions of those people to the development of the Internet technologies (e.g. Castells, 2003). What Andy, a Political Science major, described about his computer use was very much like a typical computer geek. He had been involved in a lot of technical activities for his hobbies. One of his hobbies was building up-to-date computers by himself, which he called as "a very expensive hobby." As briefly described in Chapter 6, he first considered pursuing a CS minor because of his profound interests in computers but decided not to after finding out that many core CS classes were more about math than computers. He found that IT classes were more interesting to him, compared to the CS classes that he had taken. Besides, he did not want to link his technical expertise to any of his possible future careers. He just wanted to keep his technical competency for his hobby.

While Andy was a typical computer geek, Dave just liked to work with different computer technologies. Dave's interest was more in discussing social implications of IT. Dave said that he had had inherent interest in technologies since he was young. Dave enjoyed his IT support work for the group of students that he belonged to. For example, Dave was like an IT guy at his house that he shared with seven other house mates. He clearly indicated that he did not want to go into an IT profession, but enjoyed his role as a voluntary IT support guy among his housemates. He helped his housemates by fixing hardware, installing software, installing networking, changing TV settings, and setting up an xBox game tool. Unlike most students' negative stereotype about IT support role, he was happy about his role. The reason he enjoyed that IT support role had to do with his self perception of classifying himself as a "people person." Therefore, despite lacking interest in having this kind of IT support job in his future, he enjoyed this work. For him, IT is just about his personal interest, not a means to an end.

Inherent interests were also expressed regarding social implications of IT. For example, learning social implications of IT made Matt feel IT education interesting. Matt was a returning student after eight years of service for the U.S. Navy. Impacts of IT on various aspects of society that Matt had witnessed while serving in the U.S. Navy made him have some passion in learning about the social ramifications of IT. IT education did not bear much practical value to him, as he had a clear plan to finish his college degree in Computer Engineering and pursue a job as a Computer Engineer. For him, taking IT classes were more about his interests, technical or social, rather than any practical considerations.

7.2.2 Practicality

While the above participants emphasized their pure interests, some other participants explicitly mentioned that they wanted IT education purely because of its practical value, not due to any sort of interest in the subject matter at all. These participants strongly argued that they took IT classes not because they liked them, but because they found the topics were useful for them in some way. For example, Brad did not like using computers very much, but he found Microsoft Excel very helpful and necessary for himself, as a person who was starting job hunting in the commercial banking field. He also thought

that knowledge of building a web page was some important knowledge that everybody should acquire.

Kate, an English major, focused on the relevance of IT education for her graduate study in Library and Information Science. She emphasized that technologies were not where her strength was, nor did she like to deal with computers, but desperately needed to acquire some knowledge and skills of technologies because she believed that they were necessary for her future career as a librarian.

> I didn't really think too much about it [the IT minor], because of the word "technology" in the title, that kind of scared me away. But then after I decided to look into becoming a librarian, really the biggest thing was that it was offered through GSLIS [the graduate LIS program]. So I thought it would be a good experience, and give me a foot into the door here..... I know that I am gonna need to know things about Internet and technology. It's just hard, it's hard for me.

She continued to emphasize that the only reason she took IT classes in spite of her perceived incompetence was that she wanted to have a confirmed path to put her feet into the door, as the IT program at that time was being offered as an undergraduate program within a graduate LIS program.

> I didn't really know what to expect with the minor, and I wasn't really sure what it was about. The only reason that I took it was, to take classes here, with the professors here. So a lot of... I am not really that much interested in a lot of the things that are taught about in the courses. I know people who might be interested in them, but I am usually not.

Many participants who were non-technological majors felt that technical skills were very hard for them to learn. These participants justified a reason of learning those difficult technical skills based on an expectation that those skills might be useful in building their career in certain fields. As Aaron stated:

> When I thought of Humanities [from a class titled "Computing and Humanities"], I thought it was gonna be more... I was thinking about histories, and arts, and different things. I didn't anticipate a lot of computer programming, with the

> HTML and XHTML. So that was a sort of surprise for me, but it was interesting to be able to learn some of the concepts, because I think HTML and XHTML is gonna be useful for any career I go into. I got a little bit confused about some of the technical details... Maybe I was anticipating a little bit more with the humanities, not so much the background on how does a hard drive work, how does a certain thing work.

Traditional computing majors also mentioned that they would seek IT education purely for practicality. For Zachary, a CS major, the main reason of taking IT classes was to fulfill his general education requirements for social sciences. He needed to take two social science courses to fulfill his general education requirements. Because he did not want to go too far away from technical issues, he decided to pick two IT courses for his social science requirement. He found that it was difficult to find social science courses from most social science programs, because most social science programs took technology-related topics as advanced topics, and offered courses that address those topics only at a higher level for junior and senior students in their own fields.

To Zachary, the value of learning social implications of IT was also in its practical value of filling his general education requirements. In addition, Zachary was very much interested in looking into how IT is being used in workplaces. He wanted to get something practical from an IT program to supplement his CS major. As a senior at the time of the interview, he was interested in how his study in CS could be integrated in practices. He expected that the IT program was a field that could give him such information.

> If there's a course that mixes business and technology, and what you're gonna do with it, rather than those topics in the courses like "oh, how do people use email?" that type of things..... I took the course last semester that taught about workplaces. I thought it would be interesting to see how it affects workplaces. I was expecting more practical application of it. You know what are companies actually doing with IT, as opposed to more of sociological impacts. That's why I am feeling bad this semester. I definitely would have preferred more the practical

> approach to it.....I'd be interested in integrating IT systems into business [than HCI]. Less on the research portion of it, but more on the practical things...

7.2.3 Mixed Interests: Passion and Practicality

Participants who showed either inherent interest only or practicality only were relatively few, compared with the number of participants who expressed considerations in both, passions and practical value. For the majority of participants, interests in the subject matters, either technical or social, and practical considerations co-existed. Most students who expressed a strong interest in the subject matters also expressed their practical considerations. Except for those participants who explicitly denied any practical advantages as described in the previous section, most participants expressed their practical interests in learning IT. Participants said that technical skills, especially web design skills, were valuable in that these skills would be handy across the board, which would be transferable no matter what field they decide to go into. Often, students pointed out that a lot of post graduate topics have to do with technologies. As Jack stated:

> I really think this field of study is useful to anybody, because so many post graduate basic topics are dealing with technologies now. Whether it be continuing your studies, or going to the job field. Any job now, you need to know some sort of computer skills, any skill set, or any career I guess, is appropriate for this minor study program.

Some Humanities majors found the value of IT education from the fact that adding IT education to their study would make their education sound more practical. Claire, an English major, pointed it out:

> I think that it makes your education sound more practical. I think it does make me more marketable as far as, if I get a job in editing, or if I get a job working with a company doing writing or something English-based, it helps a lot that I have taken IT minor for relevant computers skills and technologies for the job.

Practical concerns were most commonly found in their interests in learning technical skills in IT classes. Those who were interested in learning web design/programming skills tended to look at the practical value of the knowledge and skills. Eric was running

his own business, and had strong preference for classes that taught technical skills over classes dealing with social implications of IT.

> I am not as much interested in other IT courses [IT classes that deal with social implications; such as "Computing in humanities" and "Literacy in the information age"] because they sound much more theoretical and abstract... kind of how technology is being used in certain settings, how it has impacted the society as a whole, rather than how any one particular system was developed. I was more interested in practical applications. Discussing accessibility and that sort of thing... That's something that any designer should understand, but it's not my particular field of interest, so I am inclined to look at things more practically rather than from societal aspect of it.

Eric especially felt that the "Entrepreneurial IT design" class was what he exactly was looking for, as the class directly dealt with the issues he confronted in his web business. To Eric, classes that deal with practical topics were more interesting to him, because the practical knowledge was very useful for his business. He felt that the classes in his major, MIS, dealt mostly with theoretical topics, not as much practical technical skills as he would like. He found that he could apply the practical technical skills directly to his business.

> "Entrepreneurial IT design" sounded like pretty much exactly what I was looking for. The company that I've started is an IT sort of company, so the perspective of taking the class that is IT design for entrepreneurs sounded like exactly what I am already doing and I wanted to get some theoretical background for it.

In particular, Eric really liked the "rapid prototyping method," which was taught in that class. He thought that it was a very practical approach to program something, which was very useful in dealing with many real world situations.

> Rapid prototyping, that's been really handy for other classes that try to solve a problem. It seems like not necessarily just practical to IT but completely across the boards whenever you have a problem to come up with as many ways as possible to solve a problem.

Practical considerations were found in their interests in learning social aspects of information technologies as well. Often, those who were more interested in learning about social implications were interested in learning what was really going on in workplaces beyond a school setting.

Participants who saw practical value in learning social implications of IT expected that they could look into future workplace that they had not experienced yet by taking classes in IT. For example, Larry indicated that he wanted to have some new courses that would introduce future workplaces to students.

> Honestly I would be interested in an IT class that looks at, I don't know if it is related to information technology related, but maybe the future of workplace? Basically a course focuses on future technologies... like, all the courses I've taken covered future technologies a little bit, but I would be really interested to see a course that covers a lot of the technologies that will come, not just in the near future, but like even further into the future. That would be really interesting course to take.

Larry anticipated to obtain an overview of workplace technology through the IT classes.

> Probably mostly gives me an overview of workplace technology. Technology that's gonna be used for work basically..... Probably, actually anyone [should consider the IT education]. I think everyone should consider it. Anyone who's gonna work a lot with them, technologies in the future, should really consider taking this minor, because as far as... I can't think of any major that won't have a lot to do with technology work in the future.

Jenna expected a similar value of learning about workplace technologies.

> The good thing is that it deals with more contemporary things because computers are into parts of day to day life and I think it's really useful in a career and workplace to know about computers how they are implemented information technologies.

Matt's interest focused more on how IT affected the world, than how people interact at an interpersonal level. His interest lay more in learning the advantages brought by

interactions enabled by IT innovations, less on people's interactions mediated by IT. He took it as more practical knowledge of understanding current affairs.

> I started taking it [an IT class that dealt with social issues], and it did not really grab my attention as I thought it would, and therefore I did not put much effort into it as I did in other courses. I expected discussions about different technologies, how things have changed or enabled the world either brought us closely together, that type of stuff. Where we might be going, or how we adapt to where we are at. Not necessarily interpersonal relationships between people and everything like that..... I don't care about online relationships between two people or anything like that, I am more interested in how I can use my engineering degree to help make people's voices heard more effectively. How we can use technology to enable democracy to be what it should be, that kind of stuff.

Overall, many participants' motivations were mixed. Therefore, the blend of passion and practicality was the characteristic of students' motivations for formal IT education. Often, students' mixed motivations were geared more toward their practical considerations.

7.2.4 No Desire Group

The importance of the practical value that students seek from the IT education was demonstrated by a few participants who could be grouped as a "no desire group." This group of participants rarely showed any notable level of desire to seek formal IT education. It was not unexpected, considering the way through which these participants were included in this study. In general, these participants were enrolled in an IT class as a Communications elective, not as an IT elective. This group also included a student recruited from outside of IT classes.

Like other participants, they did have some interests in learning technical skills and social implications of IT. These students did show a little bit of interest in obtaining technical skills of web page creation. They also showed a little bit of interest in learning social implications of IT. Like Lauren, a Sociology major who was among this group, stated:

> If I was more involved in IT, a lot of these courses would be great. Some of them don't cross with my major but they seem interesting just on their own, like "Emerging Technologies." It would be interesting to see what's coming up...

These participants also had the awareness that knowledge of IT was becoming important, to everyone who lives in the contemporary time. Tom, who did not show much interest in learning and using technical things, nor had taken any CS or IT class, said that he did not have any interest in learning programming at all, but still would be interested in taking a web design class. He commented that although he was not interested in computer science or programming itself, web design skills was worth learning.

> I can see myself taking intro classes or certain kinds of software... Not like programming... Because, I don't know. I don't really see myself doing programming. I would probably take a web design class..... I just think that it's interesting, and I think that it's a good skill to have. I know that even for student organizations, being a web master is really helpful... it's a big responsibility. It's a good experience, I think, but not something that I know how to do yet.

However, none of these interests or awareness of importance was strong enough to make them interested in pursuing formal IT education. The reasons that these students were not interested in an IT education program were that they had a clearly developed career plan that was not much related to intensive use of IT. Therefore, IT education did not have much practical value for their future plans. For example, Lauren, a Sociology major, expressed some interest in IT topics, but did not have any intention to pursue the IT minor. She indicated that IT was out of her focus, because she considered that the IT minor was not practical for what she was planning to do after graduation. It was not very relevant to her academic interest in Sociology either. The IT minor did not have much bearing for Lauren, because she believed that the social work field that she wanted to go into did not have much to do with IT innovations.

> IT minor is out of my focus, because this is not practical. It's not something that... I don't think it would be helpful for my career, or my major, so probably I wouldn't have been interested.

Lauren's remark implied that if IT is not well aligned with students' future plans, they would not become interested in the IT minor program. The same practical value was expressed by Tom and Taylor. Tom was pursuing a job in the social work field, which he believed did not have anything to do with technologies. Taylor was a sophomore in Finance. He already had a clear plan to go to a law school after finishing college. He did not feel that the IT education had any practical value for his plans.

For this "no interest" group, IT education did not have much practical value, neither in terms of their everyday uses, nor for their future career plans. They did not have much inherent interests in IT either, as they did not specifically enjoy using or discussing technologies. In general, these students were pursuing career fields that they thought were not closely related to technologies in any way. The findings confirmed that practicality is an important dimension to understand students' interest in IT education.

7.3. Summary

This chapter explored students' diverse interests in and motivation for IT education in college. Students' interests in IT education were dispersed around two poles: learning technical skills and learning various social implications of IT. Technical skills appealed to them in that the classes teach technical skills to enhance individuals' competency of working with IT. Social topics appealed to them because students could relate class topics to the changes that they were currently experiencing. Many participants had mixed interests in the technical and social topics. The mixed interests were often expressed in their interests in users and usability of computer systems. A large part of students' interest about IT focused on usability of IT applications for end-users and IT use contexts. Participants frequently used the expression "Human-Computer Interaction," to describe their interests in IT education. Students who showed more interest in technical issues were interested in designing more user-friendly computer interfaces. Students who showed more interest in social issues tended to frame the implications of IT as "broad human interactions with computers." The overall area of IT portrayed in students' mind was "how humans and computers interact," which did not correspond to the Human-Computer Interaction (HCI), the term being used within the CS community. Rather, the

"how humans and computers interact" indicated a more broadly conceived field that deals with general human interactions with computers.

Students' motivations for IT education were dispersed around passion and practicality. Some students were pursuing IT education mostly out of their passion, and some others mostly because of their practical reasons. However, the majority of the participants showed mixed interests in both. Often, practicality was a stronger motivation. This result implied that students' practical considerations in taking IT education, as well as their inherent interests, should be considered seriously. In sum, the mixed interests and the mixed motivations characterized students' perceptions of college-level IT education.

8. STUDENTS' UNIQUE EXPERIENCES IN THE IT CLASSES

This chapter explores students' actual experiences in the IT classes. Most interviewees who participated in this study had taken one or more classes in the IT program by the time of the interview. The most characteristic aspect of the IT classes was pointed out as the interdisciplinary nature of putting previously separate topics together. Both the strengths and the problems students felt about the classes were associated with the interdisciplinary nature of the IT classes. Participants also reported that the IT program was an unusual opportunity in college which was at an advanced level of undergraduate education in many respects. This chapter explores students' unique experiences in the IT classes.

8.1. Interdisciplinary Nature

8.1.1 Incorporation of Previously Separated Topics

Participants pointed out that bringing the Humanities/Sociological perspectives together into the understanding of IT as technologies was the most distinctive aspect of IT classes. For example, Kelly, a Media Studies major, pointed out that the hallmark of IT classes was bringing two previously separated areas, IT and the Humanities, together.

> It's putting two things together that don't necessarily go together. Now we see them embedded together a lot more easily, but in previous decades, computing and sciences were very hard, and humanities were a more soft discipline. So to put them together has been a challenge. So this course looks at that, specifically it's kind of even an overview of what the minor is in total, which is looking at, trying to incorporate technology and information into many types of workplace.

Many participants stated that they had learned about the social and historical contexts in which information technologies are situated, by having opportunities to look at computers from a perspective that was different from the technology focused viewpoint of the traditional computing disciplines. Nathan, a Computer Engineering major who had intensive experience with computers through his academic training, saw his experience of

getting different perspectives of viewing computers as valuable. For him, understanding of "how information technologies are used" obtained from the IT classes was valuable add-on knowledge to his expertise in "how technologies work."

> So I was looking through there [list of courses that satisfy general education requirements for engineering students] for Social Science courses and saw that. It looked interesting. It definitely stood out among the others, something that may be a different perspective, telling something that I already knew, and that's actually what it turned out to be. The biggest difference is the perspective it takes, the approach to looking at all this information technology resources. So it's not an understanding of how they work. It's an understanding of how they're used, which is a very different approach.

The value of gaining different perspectives of looking at computers was expressed by non-technological majors as well. These students also felt the focus of the IT classes which was on the relationship of computers with contextual issues, rather than computers as pure technologies, was valuable. Aaron, a History major, also stated that he got a different perspective about computers from the IT classes. For him, computers might have not been previously related to social issues such as race and gender. However, he felt that an opportunity of viewing computers in relation to those social issues was valuable.

> I liked the "Race, Gender, and Technology" class. That one got me a different perspective. I definitely learned a lot, had a better appreciation for just... What the IT minor appeals to me were different aspects of information technology courses and learning about IT.

Participants welcomed what was being taught in IT classes, in that they were able to learn about different perspectives about computers which they were using everyday, instead of the difficult and abstract computing principles typically taught in traditional computing classes. Technological issues and social topics have not been taught in connection with each other, but participants felt these missing links between the two areas were being well addressed in the IT classes.

8.1.2 An Opportunity to Learn from Peers

A noteworthy feature of the IT classes in this study is that students from diverse majors gather in the same class settings. Participants reported that they obtained the different perspectives of viewing computers not only through the interdisciplinary curriculum, but also through class interactions with other students who came from different backgrounds. Participants developed an appreciation for different perspectives from their interactions with these classmates from different backgrounds. Kate, an English major, said:

> I've got quite serious students, which is nice, because they often either have more knowledge or different perspectives, so it's nice.

Students from IT-related majors also saw the different perspective of viewing computing they had obtained through their interactions with their classmates from different fields as valuable. Nathan, a Computer Engineering major, was glad that he had classmates from other disciplines who brought different perspectives about technologies to the IT classes.

> I loved having opportunities to work in group projects with people outside of engineering. They have different perspectives on things.

Group projects that were frequently assigned in many IT classes were pointed out as a significant opportunity in which students were able to interact intensively with other students. Many participants reported that their experience of working together on a group project especially motivated them to learn more about IT. As each student brought his or her own expertise of IT into the classes, IT classes provided students with valuable opportunities to learn from their peers. While working together on a group project, they discovered how students from various expertise areas could contribute to completing a group project.

In Chapter 4 and Chapter 5, comparison of students' IT competency with that of their peers was pointed out as a significant factor that greatly motivated students to learn IT. The significance of the influence of classmates raised in the process of carrying out group projects was also consistent with the finding that students' perceptions of IT competency were a generational phenomenon. Participants thought that they had higher IT competency as a group than that of older people, and at the same time did not care about

younger people's adeptness of dealing with IT. They frequently gauged their IT competency in comparison with their peer groups rather than with older or younger people. IT classes provided a significant context in which such peer comparison actively occurred.

8.1.3 Blend of Different Disciplinary Practices

Being interdisciplinary does not only mean that class topics from different disciplines are mixed. Each discipline has its own class practices, and an interdisciplinary curriculum would also bring those different class practices associated with the contents of each discipline into a class. Class practices are some kind of shared understanding among students and instructors about what is expected in the class. Unlike class agenda, class practices are not usually communicated explicitly among students and teachers. Instead, the expectations are often made implicitly, rather than communicated explicitly. Often, participants were accustomed to the class practice of their own major field while not used to the class practices of other fields.

While the interview participants did welcome the different perspectives of viewing computers drawn from different disciplinary traditions, they did not as easily embrace the different class practices that often accompanied the contents from each discipline. As these unspoken expectations were mixed in the IT classes, students felt uneasy about adjusting to these mixed class practices. It was a contrast to the finding from the previous section that students generally welcomed the characteristic practices of IT classes that put traditionally separated topics together.

In this study, some participants expressed difficulties of adjusting to the class practices which were different from those of their major field. For example, Humanities students commented about the difficulty of adjusting to the different styles of readings assigned in the IT classes. Kate, an English major, mentioned her discomfort of dealing with the different styles of the class readings. She stated that she felt that the readings assigned from IT classes were more technical and dry than the readings in English, as she was used to more literature style of reading.

> Since I am an English major, I am used to reading novels and literature, and these types of classes are doing more academic reading, or things like that. The

> coursework is different, instead of papers, it's more participation-based, and project based. Usually there is one big project at the end. Groupwork is different, because I am an English major, I don't work in groups normally.

Complaints about different styles of readings were made by a Journalism major as well. Abby, a Journalism major, indicated that she was familiar with newspaper article style and had some issues about readings in a different style.

> I didn't like those specific readings [in an IT class]. I liked some of them, but some of them are really long. Maybe it's because my major is Journalism. I was reading things more concise, and for like audience of anyone, but some of these were... when people write studies and stuff, that are trying to sound so intellectual and smart, when nobody can understand them. So that annoyed me.

Different class expectations of IT classes were another thing with which participants expressed discomfort. Zachary, a CS major, argued that CS classes usually put most course materials online and gave grades mainly based on the quality of the homework and test results, regardless of physical class attendance. He asserted that attendance was not a big requirement for CS classes, as long as a student satisfies course expectations with homework and test results. Unlike those CS classes, the IT class that he was taking did not put class slides online, and required him to show up to every class, which he found difficult to adjust to.

> The course materials [of the IT classes] are not that difficult. The more difficult thing is showing up to class for me, because I am used to not waking up until noon.

Another example of such different practices was the grading procedure of the IT classes. Zachary, who was mentioned above, felt that he lost points from an IT class for the mechanics that he would lose points for in an English class. As explained earlier in Chapter 7, the major reason that this CS student chose the IT classes was that the IT classes were the most closely related Social Science classes to CS. However, the different practices of IT classes were a challenge for him which he had not expected.

> In my paper for this course, I got a lot of points taken off for the stuff that you would take off from an English class, not in an IT class so much.

8.1.4 Content Overlap among Classes

Participants reported that there was a lot of overlap between the contents of IT courses and those of other courses offered from other programs. It may be a necessary consequence of being an interdisciplinary area that draws different pieces together from different disciplines. Especially, overlap with social science topics, such as topics in Advertising, Sociology, and Communications was frequently pointed out.

Jake, an Advertising major, stated that IT classes dealt with pretty much the same topics in his major, except that the IT class focused more on technologies.

> Basing it off one class that I took before, they are talking about pretty much the same topics but we didn't talk about technologies. But I find it interesting.

Sociology was pointed out as another field that had a lot of overlap with the IT classes. Lauren, a Sociology major, pointed out that there was much overlap between an IT class she was taking and the classes she had taken in Sociology.

> Definitely this class focuses more on technology than my other courses obviously, but I mean, there's a lot of overlap I would say... because we do talk about relationships from other courses. It's just specific to technology in this course.

Overlapping contents may be a necessary consequence of being an interdisciplinary area of study. A certain degree of overlap among classes may sometimes be desirable, as the overlap enables students to connect the separate pieces of knowledge and build up a comprehensive understanding upon their prior understanding. However, a more serious problem was a lot of overlap among IT classes within the IT program, which participants frequently pointed out. For example, Claire commented that there was a lot of overlap between the two core IT classes.

> 202 [an introductory core class] and Capstone [a required core class to complete the IT minor] are basically the same one. So it should be just one of those.

While overlapping between IT classes and classes in other programs may be a necessary consequence of being an interdisciplinary field, overlapping contents among IT classes

within the program need more attention, because it may be a signal that the structure of the IT curriculum was not tight enough to help students build a comprehensive understanding.

8.1.5 Exposure vs. Skimming Different Topics

Participants pointed out that one significant value of IT classes was that the classes introduced various IT-related topics to them. They also indicated that the classes introduced important IT topics being addressed in the real world outside of school, which they were not easily aware of. They indicated that even a small piece of information about new technologies made them want to obtain more knowledge about those technologies. Classes served as one of the opportunities for students to be introduced to new topics of IT. Evidence that exposure to different technologies played a significant role in motivating participants to learn more about technologies was found in Jenna's comment.

> I mostly understood the lectures, and I wish I knew more about computers when we talk about the new programs that are coming out. Sometimes she [an instructor] talks about new programs... The computer lingo that sometimes she uses, I sometimes don't know what she's talking about, I wish I would know more... When she [an instructor in an IT class] asks like "have you guys ever heard about this, or that?" when she asks those questions, sometimes I really don't know... But when she is just lecturing, I know what she's talking about. It's not that I do not understand it. But sometimes new programs, I don't know what the programs are. Then I wish I would. It's not so much I don't understand what she was talking about, but I just haven't heard of some of the things that she talked about.

Opportunities for being exposed to different topics are valuable, because people often do not realize the need to learn IT before they have experience with those technologies. For example, Larry, an English major, said that he had not recognized the significance of databases until he experienced them in an IT class. The reason indicated was that he never had been introduced to databases before he worked on a class project in the IT class.

> I suppose the newest one [that I learned] is databases, which I learned in 310 class. It was hard especially for those who were not from a technical background.

Opportunities to be exposed to different technologies are taken significantly in the existing studies on the digital divide (e.g. Goodson and Mangan, 1996). As learnability of computer systems has been greatly enhanced, an effort that simply increases opportunities for people to experience those technologies itself may enable people to equally enjoy the benefits that technologies have brought. These studies often state that providing equal exposure to different technologies would enhance people's chances to develop their abilities to utilize computers. From those studies, the value of exposing students to different topics in IT classes can be inferred; introducing diverse IT topics to students in itself is a valuable attempt.

However, sometimes students felt that the IT classes just skimmed many different subjects in a short time span. While exposure to various new IT concepts and applications was valuable, skimming many different topics, which is the other side of exposure, was determined to be a major problem of IT classes. Some participants found it valuable to go over many different topics as it offered opportunities to get to know different technologies. Meanwhile, other participants pointed out that IT classes went over many subjects quickly without going into any of them in-depth. For example, Kelly, a Media Studies major, appreciated the value of being introduced to different topics.

> I think it's [the value is] just exposure to it [IT]. Knowledge of what's out there, how to comprehend it and discuss it. It's probably the biggest thing.

On the other hand, Lucy, a History major, complained that her IT classes were in a rush to cover a number of different topics. While Kelly took the exposure to be valuable, Lucy criticized that skimming just resulted in "not getting the full appreciation of the classes." These two students' contrasting comments showed the two opposite viewpoints of the exposure.

> In this class, we moved very fast. I feel like we did jump from one subject to the next each week, we never... it's like we skimmed the surface but didn't go into it. I guess that was kind of hard at first. It's good that they introduce us to the technical skills. But I think it is kind of bad that in a way they are skimming

> over... so we are not getting exactly full appreciation of them. Because we're trying to balance both technical stuff and humanities aspect of it, it's like we're almost getting a little bit of both. It's almost like it could be two classes. So it's like all jumbled together which makes it a little bit, so you're getting like a half way I guess.

The problem of skimming was more serious in IT classes that focused on technical topics than those focused on social topics. Skimming many different technical subjects was criticized for not allowing students to go any deeper into any of the technical activities. As Kate said,

> We had such a wide range of things in the class. I've got a little sniff at things, but not real expertise in any one thing. I learned about HTML, and XML, and other things, but I don't know if I can actually go off and do something with it myself, which is a kind of an expectation at the end of the course.

Emily, a Psychology major, took an IT class where a group project of building a website was assigned as their final project. She said that technical things were "thrown" at the very end. She felt that she had not learned anything technical from the class throughout the semester, which would help her conduct the final project. Technical activities just being introduced in a short period of time did not make for real learning.

> In 201, we had a little bit of html stuff thrown at the end, and I totally didn't get it.

Emily said that it happened not only in that specific class, but also in most IT classes in general. As the classes skimmed many topics in a short time, she repeatedly said that "I didn't get it."

> In programming web mashups, we spent a lot of time learning html design, and then more complicated stuff like PHP, I really didn't get it because we learned it really fast. So I'd say if I were to redo the class, I would want to spend less time on the easy stuff, and more time on difficult stuff, and make sure that people actually master it. I think lots of people had the same problem, because PHP is very complicated to just somebody who really doesn't have a real background in programming.

Students took dealing with different subjects sometimes as "exposure," and sometimes as "skimming." When the value of the interdisciplinary study was understood as "exposure," students took the IT classes as invaluable learning opportunity. However, when the same practice was viewed as "skimming," students raised questions such as if IT classes could be in-depth learning.

8.1.6 Unclear Class Expectations: "Did Not Know What to Expect"

One big problem that came up through the interviews was that the participants were unable to have clear expectations about the IT program. A surprisingly large percentage of students commented that they did not know what to expect from the IT classes. Most of them just came to the program with a vague feeling that learning technologies was important. Several participants just came to the program as a means to get their foot in the door of the parent program of this specific IT program, the graduate program in Library and Information Science. This comment indicated that the young IT program did not give students a clear guideline about what students should expect from this education opportunity.

The IT education is a young academic field, and a common perception about the classes was "brand new." It caused confusion about "what it is." The most common response to the question that asked their original expectation about IT classes was "I did not know what it is." Lisa described the class atmosphere of an IT class, where each student had different pre-conceived expectations.

> I think a lot of my classmates came in with different pre-conceived notions about what it would be and what it actually is... So we didn't really know what to expect from it.

The unclear identity caused a lot of confusion to students. Many students pointed out that they did not know what to expect from the IT classes. Kate specifically emphasized that she did not have any idea what to expect.

> I really wasn't sure what to expect. It's all about humanities computing, and I had no idea, what that was, going into it. I just took it because it's less scary than the science one to me. I am very much a humanities, not a technology person. I didn't

> know what to expect, and I guess it's different than what I had originally expected... it's definitely more focused on computers than humanities.

Another participant, Emily, stated that she chose to take one IT elective class, Museum Informatics, simply because of her good childhood memories about museums. She stated that she did not know what to expect in that specific class although the subject matter interested her a lot.

> Reasons for choosing the Museum Informatics class? I love museums, when I was little, my family went to museums all the time, Saturdays and Sundays, if we didn't have other activities... I have happy memories about museums, and I want to learn more about them – but I wasn't sure what to expect. We do a lot of readings, about various aspects of technology use in museums, and then we have a chance to go to museums, look at the museums there, see how it applies.

In particular, students were also unclear about the technical expertise requirements of each class. Students did not know how much technical expertise would be required. As Jenna stated:

> I was kind of intimidated at first to get into the IT minor, because I didn't know what it was all about. But I like how it offers courses that are technical and not so technical, kind of both aspects..... All I expected about the 202 class was that it would not be too technical. I was looking forward to looking at computers in another way.

Lucy even stated that the only thing she was able to tell about an IT class was its physical classroom arrangement. She noticed that one class was held at a computer lab while other classes were held in regular classrooms. From the different physical classroom arrangement, she guessed that that specific class would involve technical hands-on skills. She chose that class just because she was curious about what kind of computer skills she would use as one of the Humanities majors.

> Another class that I am taking is "Literacy in the Information Age." That's what it is... I didn't even know what that was. You know, I was curious about it. Before I took them, I didn't know how it is different from the other class I am taking. The

> only reason that I guessed they would be was, I knew what rooms they are in. 310 had computers... so no, I wasn't sure how they would work exactly.

Participants felt that instructors, not only themselves, were also struggling because there was no clear expectation about what an IT class was supposed to teach. Kate said:

> There are things that are difficult. They try to make it not difficult by helping us, taking the pressure off but walking us through, and especially at this point we stopped the class and having quizzes, weekly assignments, but as far as the material, it's challenging..... There are a lot of things over my head... I think, over the heads of a lot of people in the class... hahaha... but we're working into it. The professor's adjusting the course for us.

Most participants did come to the IT classes for some reasons of their own, but it did not necessarily mean that they knew what to expect from the classes or what to do with the knowledge they would obtain through the classes. At the beginning of this chapter, it was reported that students especially welcomed the combination of technical knowledge and social implications, which had not been previously connected together. However, the unusual combination of the subject matters causes confusion about what to expect from those classes. Not providing clear expectations may only result in reinforcing students' instrumental reasons for taking the IT education opportunity, such as completing the minor requirements or the general education requirements, rather than promoting their intellectual curiosity in the subject matters.

The findings of this section all indicated the characteristics of the IT program as an interdisciplinary area. Students felt that putting different things together as the most valuable aspect of the IT classes. However, being interdisciplinary is challenging, as putting different things in a short time span can be felt as skimming that would not result in in-depth learning. Also, combining traditionally separate topics, technical and social, together caused students' confusion regarding what to expect from the IT classes. Findings from this section pointed out the challenges of organizing an IT curriculum which should be interdisciplinary by nature.

8.2. Technical Expertise Requirements: How Much is Enough?

Among the many challenges of being an interdisciplinary area, incorporating technical components in the curriculum was most controversial. Therefore, students' perceptions about incorporating technical components were investigated more in-depth.

8.2.1 Conflicting Attitudes toward Inclusion of Technical Components

Participants pointed out that the most characteristic aspect of IT classes was inclusion of the technical components into the curriculum. The combination of technical and non-technical was agreed upon as the biggest strength of the IT program. As Chris stated:

> That's what I think is great about the minor, because it has offerings for both technically competent and less competent. They both would have offerings for just those two kinds of applicants, someone who is really after understanding the hardware aspect, then X [name of an instructor]'s course is good for them. If they are really unsure about computer hardware, but really want to discuss the influence of computers on the society and personal life, Y[name of another instructor]'s discussion course is the way to go. And both are offered through the IT program. And I think it's the way it should be.

Incorporating technical components was also taken as important in maintaining the face validity of the IT classes that were expected to cover a range of topics related to information technology innovations and applications. Regardless of the debates about an appropriate level of technical components, utilizing IT was commonly taken for granted in running an IT education program, as students felt that technologies were the core of the program. Students generally expected that IT classes should utilize various technologies for classes more than other typical college classes. As Zachary said:

> I don't understand why she [an instructor of an IT class] doesn't put the slides online. Especially in an IT class, why would you not utilize computers to facilitate better learning? It seems kind of silly that in an IT course the professor does not use IT to give us lecture slides.

In spite of the perceived necessity of incorporating technical components into the IT curriculum, these technical components were pointed out as the most controversial factor

for students to take the IT education opportunity. While many students saw the classes that taught practical hands-on skills as the biggest strength of the IT curriculum, they often commented that those technical classes were so hard that they sometimes hesitated to be enrolled in such classes. This conflicting attitude about the technical requirements was common across most of the participants. It pointed to the biggest challenge of being an interdisciplinary class that blends technical components and non-technical components together.

8.2.2 A Subjective Balance between Technical and Non-Technical Components

While most participants generally valued putting technical and social components together, every participant conceived the optimal balance between technical and social issues differently. It seemed that the optimal balance between technical components and non-technical components was very subjective in each student's mind.

Participants' attitudes towards the technical requirements were somewhat contradictory. Many participants liked IT classes that teach hands-on technologies, but at the same time indicated that they were struggling with those technical requirements. Even students who picked mainly technical classes because of their strong interest in learning technical skills pointed out that the technical requirements of IT classes were higher than they thought. One English major, Kate, repeatedly said that the technical requirements in IT classes were much higher than she had expected.

> "Computing in humanities" is definitely more focused on computers than humanities. It's a lot of... kind of computer history, and computer coding, and we talked about HTML, and things like that, that are just really kind of over my head... I think, over the heads of a lot of people in that class.....The technical component of the class is very challenging for me. A lot of the times... almost too challenging. It depends on what class it is. A lot of it is really hard for me. I just feel like a lot of times "I don't get it." I don't know. That class, it's a lot more focused on computers and coding. It's really hard.

Many students desired to learn practical technical skills without needing to know too many theoretical details and fundamental principles. However, learning technical skills this way caused mixed feelings. They admitted that learning technical skills without

fundamental principles and repeated exercises might not be very effective. Many technical activities build on mathematical ways of thinking, which typically builds over a long period of time. For example, CS people build their programming skills on a firm basis of math and practice them over a long period of time. Hence their programming skills and knowledge are not easily lost. However, participants worried that they had not been trained in that tradition, hence their technical knowledge and skills that they obtained in a quick and easy way might be easily lost.

Fear about carrying out technical activities in IT classes was frequently expressed by many participants. Lisa, who stated that her overall IT competency was okay, also expressed her fear about working on the technical assignments in IT classes.

> 310 [Computing in Humanities class], I don't like it because I don't have the technical experience, and so I am struggling to make it work, but I am doing an okay job. We have a project, we have a plan, and everything is getting done, but there's still like a worry that for each of us it is a little more technical....

Students' anxiousness about the technological requirements in IT classes was related to peers' recognition and class evaluation. Many participants said that a significant contribution to a group project was made by those who had programming skills and hence directly contributed to create an output. As described in Chapter 7 when the reasons that students valued practical technical skills were explored, Jenna indicated producing an artifact with programming languages was the most visible and unique contribution to their group projects and expressed a strong desire to be able to contribute to their groupwork with the programming abilities. That was a very common feeling among non-technological majors. Kelly also regretted that she did not have programming skills for the same reason as Jenna.

> One of the things that really concerns me going into group interactions is that I don't have very much programming [experience]... I can just deal with general Microsoft Office, that's about it. So I was really worried about it, and especially with the group project, like how I might be able to contribute....

This feeling often continued to become a concern for a possible unfair evaluation in class, because they took technical expertise as a significant part of class contribution. Lisa

raised a fairness issue in evaluating in classes. She thought that those who were successful in IT classes were those who had higher technical expertise.

> People who were always really successful in the minor classes were always Computer Science majors. So... I don't know... I think to a certain degree... but that's not what this is about... you don't want to turn it into another Computer Science program. But I think that to a certain degree, some classes are difficult to achieve without a lot of computer expertise.

In the mean time, some other students found out that the IT courses were less-technical than they expected. They welcomed that the IT classes did not require as high technical expertise as they originally expected. For example, Jack welcomed that the IT classes were less technical than he originally expected.

> It's a lot more oriented around discussing different technologies. Others have a little bit of technical knowledge, but this one is more... almost like humanities, we actually looked at how people interpret and use the technology. It's less technically oriented, which is kind of welcome..... I am pretty well set with the IT minor. They've been a commonplace between classes. It doesn't get too technical to where you're lost. I don't feel awkward asking questions or anything in the classes. But for the most part, I am pretty familiar with the terminology by now.

Not surprisingly, participants from IT-related majors generally thought that the technical activities of the IT courses were easy for them. They pointed out that some topics were too basic for themselves, such as telling the difference between viruses and worms. As Zachary stated:

> Some of the stuff, I guess was kind of, for me as a Computer Science student, is too basic, like we're talking about viruses versus worms, or whatever else. I was like, "Okay, if I take another course, they're teaching them[the viruses and worms]. I'll make those." [laugh]

As seen from the above, all the participants perceived the optimal balance between the technical and the non-technical materials differently. Students' different perceptions

about the difficulty of technical components in the IT classes indicated that while incorporating technical components may be the most characteristic aspect of many IT classes, determining an appropriate level of technical requirements would be more challenging than expected.

8.2.3 Assumptions about Students' Technical Experiences

It was not only students who determined an optimal balance between the technical and the non-technical components subjectively. Students reported that the instructors of the IT classes also determined the optimal balance subjectively. Because of college students' intensive IT uses, the instructors often assumed that their students had a certain level of technical expertise. Participants' descriptions of their experiences in IT classes strongly suggested that such an assumption about students' technical expertise level would be risky. Students' comments indicated that such an assumption often entailed negative consequences in class administration and student learning.

Participants pointed out that the technical activities of the IT classes were being introduced to students with a certain assumption about students' technical expertise. The fact that many students use IT intensively and feel familiar with IT does not necessarily indicate they have enough technical competence to work with technical assignments. However, participants' comments implied that the IT classes were often planned based on those assumptions, which often did not correctly reflect students' actual technical expertise. Lisa's description of an IT class vividly showed the consequences of imposing such an assumption.

> I think they [the instructor and the TA] came in with a different expectation about what the students would be. The first day, we did not have very much technical experience, but they didn't really change the course materials or anything based on that. It took a while, a couple of classes before they realized that the discussion was very sparse, and just because people did the readings, but they didn't know what to say about it, because they didn't really understand them.

Emily pointed out that a technical project assigned at the end of the semester, after dealing with all the theoretical stuff, did not make for real learning. She stated that a group project was thrown at the end of the whole semester in one IT class, because the

instructor had an assumption that students would have that level of technical expertise, which was not necessarily true.

> [In an IT class] There was a lot of business related theoretical stuff. Then when we got to the practical applications, we didn't have enough time to really learn it. The instructor just threw it at us, and told us to go to the project, so it was a very frustrating class... I think the topics covered were very good, but I just felt like... we had to do a big group project at the end, which involved creating a working website that generates content, and allows people to make choices. I felt like we weren't really given the technical expertise to do that. We had all the theory what would make it a good system or whatever... but we didn't spend enough time on practical skills. I had absolutely no knowledge of how to do them all, so it was something totally new.

Such assumptions were being made not only about students' technical skill level, but also about students' knowledge of IT, such as their understanding of technical lingo. Jenna indicated:

> I would say 310 was pretty difficult at first, because when we started everyone was kind of overwhelmed with the language and the readings that we had to deal with. In 202 sometimes the things that they're talking about... they assume that I know everything about computers, and I don't... some of the words and phrases that they use I really... sometimes I really don't even know what you're talking about. Not a lot, but sometimes. So I would say it's hard, sometimes there is a barrier between what they assume that we know, and what we do know about computers, because it's an introductory course.

Lisa's comment implied that one negative consequence of assuming their technical expertise level would be significantly reducing students' interests in learning IT.

> Well... I enjoy certain classes. I really like the 482 class, and I think that it's based on the tone of the class to a certain degree. I didn't like 202 as well. I think that sometimes when you're in a graduate class, it can be intimidating, because they have all this experience and knowledge from other classes. I did not like the Capstone class, 491, because you are meant to come into it at the end [of the

> minor] but I didn't have any of that experience. Maybe it is hard for me... I may be just pretending to be interested because it's hard for me. But, you know, I found it to be difficult to contribute to the discussions when I didn't have the experience like everybody else did. They brought in knowledge they've gotten from other classes. I didn't have that. And 310, I don't like it just because I don't have the technical experience, and I am so struggling to make it work, but I am doing an okay job. We have a project, we have a plan, and everything is getting done, but they're still like a worry that it is a little more technical...

Participants' comments warned that the IT classes may be assuming some level of technical expertise too easily based on the fact that the students are the generation that has grown up with computers and actively utilizes computers in everyday life. As was pointed out in the previous sections, incorporating technical components may be a hallmark of the IT program. However, students' warnings that any assumption of students' prior technical expertise level would be risky poses a significant challenge in running an IT program.

8.2.4 A Suggestion for Offering a Basic Technology Class

Participants felt that the wide range of technical expertise caused a lot of problems in running the IT classes, and suggested a way to even out the different technological expertise. Students' majors widely ranged from English and History to Computer Science and Computer Engineering. The mix of students with a wide range of technical expertise was mentioned as the biggest problem in the IT classes. Participants reported that the wide-variety of level of experiences among them sometimes hindered the class progress. Some students said that the classes progressed too slowly because of technology novices. On the other hand, some others felt lost in the discussions that involved technological topics.

Lisa described the range of technical expertise within an IT class. Most students knew how to operate a computer, but did not have much technical expertise beyond that. Other students were a lot more advanced, and became even bored with the technical class activities.

> I think the bad part about it is that it's really hard to absorb the new things you're exposed to, unless you already have... at least some basic understanding of all that stuff. Every one of us there can operate computers, but we don't really know the hardware, how computers operate, so I think a lot of us still really struggle.....I think we have a very wide-range. I think one of the kids is like a CS major, there are some kids with extreme technical skills, they know everything about computers. I feel like I am in the middle, and there's some of the people I know from the things they said... they don't know any programming or stuff like that. So I'd say we're completely across the board. I think it will be hard to teach a class with people like us, how do you accommodate, I am sure that one guy is really bored, when talking about that stuff, but then other people are kind of lost.

Overall, it seemed that the wide variance of technical expertise hindered effective class administration, although theoretically each student can contribute to the class with their own unique expertise and learn from each other. While some students felt that the classes were too technical, some other students who had a more advanced level of technical skills complained that the classes were hindered by those who had low technical expertise. Eric, an MIS major, stated:

> One thing that hindered us sometimes is that there's a very wide variety of level of experiences among students... some were CS majors, while some never really touched a computer. In some situations that really slowed things down because he had to stop and explain the concepts. Some of us were elementary while others had no idea what he was talking about. We were kind of hindered by the stragglers so that the people at the higher-end were held back by that.

Even for interdisciplinary classes, some kind of shared understanding and shared objectives were necessary to run a class effectively. The uneven level of technical skills and knowledge was pointed out as the biggest obstacle against building such a shared understanding. Kelly pointed out that due to the uneven technical expertise, the classes lacked shared vocabulary. Her comments implied that class conversation would be hard if students do not have some common understanding.

> It's hard for the class to interact, because the information we are using is a little different, it's a little more abstract. The contents are kind of dry and it makes it hard to interact with the instructor and the classmates.

To overcome the negative consequences of the uneven levels of technical competence, many students suggested a basic technology course offered within the IT minor, as a way to even out the technical variance existing in IT classes. For example, one English major Kate said that a class about fundamentals of computing would be helpful. She argued that some fundamental technical stuff should be separated and taught as a prerequisite, as she felt that the IT classes would be hard for people who do not have background with technology like herself.

> I really feel like this course can almost be split into two, one semester you become familiar with technical stuff and then… or maybe can have a prerequisite.

Participants hoped that that fundamental technical class should not be another introductory level CS class. Like Emily said, they wanted a class about fundamental basics, tailored to the needs of the IT education program.

> I wished that they offer a class through IT like basic programming, like basic class in C++ or whatever. Because I heard that CS classes, like the 105, which is for non-majors, you only learn about basic Excel and some basic SQL stuff. And the 125, which is for CS majors, it's theoretical and difficult. Actually I've heard if you want to take a basic computer programming class, the best place to go to is [the community college in the campus town], because they teach you how to program without all the theoretical stuff. They teach practical stuff rather than theoretical…

Most participants agreed that this fundamental technical class would focus more on web-related technical skills rather than general computer science basics. For example, Larry indicated:

> Some parts near the beginning were really technical. So I think maybe they should either say that there is a prerequisite or technical requirements ..... There was the 391 WA, which is taught by [another instructor], I forgot the title of the

> course, it was basically an introduction to writing HTML or XML. That one definitely helped me later for the IT courses I took later. So maybe make that course a prerequisite or something, maybe not prerequisite, but just one you have to take early in the IT minor. So that in case you ran into a class that forces you to, that needs more experience with the technical side of, coding or that stuff... that would be really helpful.

As was shown so far, the most notable aspect of this interdisciplinary field was incorporating technical components into the curriculum. At the same time, incorporating technical components of this program was the most controversial. While participants pointed out that the technical components were most valuable, they perceived an optimal balance between technical and non-technical components all differently. It pointed to another big challenge that an IT program should deal with.

8.3. Unusual Education: "A Departure from Typical Studies"

While participants felt that the IT curriculum was unusual in that it combined technical and social topics, they also felt so about the "advanced" practices of the IT classes. Many participants commented that IT classes had unique class practices that were outside of the typical range of undergraduate classes. This perception was largely due to the novelty of the class topics and the approaches of dealing with those topics.

8.3.1 Unusual Topics

A common perception of the IT classes was that many topics that were being dealt with in the classes were very novel to them. Participants commented that they had not seen any other place on campus where IT-related topics like Web technologies were being dealt with. Aaron said:

> This was the first time I learned about SQL, and HTML and XHTML. This is a brand new thing for me. It's still something that I am adjusting to because it's brand new for me.

IT classes were appreciated in that they were the only place on campus where students could obtain valuable hands-on computer skills. Jack stated:

> Just for me personally, I have never taken any HTML or coding classes before, so I really thought that there is an important skill to learn, and they were pretty interesting as well..... It's just that from my electives I learned how to do HTML and that was the skill that I really wanted to learn from coming here to the minor.

More social topics such as copyright laws and information ethics were also pointed out as valuable novel topics. Kelly even felt that one of the IT classes, the "Information Ethics" class, was a unique experience that she could put on her resume.

> I think it is pretty comprehensive. Like I've got a lot .... One of the classes that I can always write about on my resume or something like that, is Information Ethics. It just taught me about why information needs ethics. I think that class is really broad. It seeped its way into my other courses. I somehow am able to... we will go over the topics, and I've already talked about copyright, I've already talked about privacy...

Students, especially those from the non-technological majors, may have been familiar with these technology-related topics in everyday life, but not in an academic setting. Therefore, they felt that everyday topics which were discussed in a class setting were novel.

8.3.2 Unusual Approaches of Teaching

Participants reported that IT classes were being administered differently from typical college classes and approached the topics in a number of different ways. Many students pointed out that one way in which IT classes were different from other classes was allowing a lot of flexibility for students to learn what they wanted to learn in a variety of different ways.

First, participants felt that the class atmosphere of an IT class was more relaxed than other classes. An engineering student, Matt, contrasted an IT class with other classes in engineering, in that IT classes were administered in a more relaxed atmosphere while engineering classes progressed on a more rigid schedule. He commented that this was a more fun way of learning.

> It was a fun, different class that provided a contrast to all my technical things. Yes, we did technical stuff in his class, but it was a much more relaxed atmosphere. We did things together, and it was just a fun, easy class.

Another engineering major, Nathan thought that the IT class required a lot of work just like other classes in his major, but the class activities were more enjoyable. He attributed it to the fact that there was less complex math.

> I don't want to say that it was easy, because it definitely still required a lot of time and effort to do well in the course, but it certainly wasn't ... because no math for one [laugh], there's no algorithms to figure out, there's not a whole lot of stuff to memorize if you attend the lectures. If you pay attention to the lecture, and if you review the lectures before the exams, it is a very manageable course.

More teacher-student interactions and more intimate discussions than in other college classes were also pointed out as characteristics of IT classes. Participants enjoyed the intimate relationships between instructors and students, which they had rarely experienced in other fields. They said this aspect resulted in facilitating more student participation and open discussions. Intimate relationships among class participants were another aspect of flexibility, more participation, and a lot of open discussions. Dave felt that he could hold conversations on recent technologies with professors in IT classes. By contrast, in other classes, he mostly had to sit and listen to lectures. He felt some distance between him and the professors in his major, in that he felt that the professors mainly focused on their own research rather than class agenda. In contrast, he could bring up computer issues as a common conversation topic with the professors in the IT program.

> I feel like the professors in the IT classes can relate to you more because I feel like the professors [in the IT program] study the stuff that we're actually a part of; whereas my Political Science teachers are there for their research, more than students... I feel like they were more interested in their own work than classroom agendas. I feel like I can relate more with the professors in IT classes than my public administration teachers for instance. I can hold a conversation with her [an instructor of an IT class] on recent technology or something like that.

That aspect of IT classes was contrasted with other typical college classes, where class discussions were mostly about tests and papers. Andy, a Political Science major, commented:

> You will have a discussion from the class, but it is limited to the extent of testing, midterm, final, and term paper.

The intimate instructor-student relationship was connected to many other characteristics of IT classes, such as their friendly atmosphere and emphasis on creative work. Intimate relationships enabled incorporating more students' input into classes and running the class more flexibly.

Many students welcomed the flexibility allowed in IT classes, but some other students indicated that flexibility was not necessarily good. For them, the flexibility of IT classes was a sign that the classes were less tightly structured than typical college classes. For example, to Larry, the flexibility of IT classes was a good thing that he enjoyed, but at the same time, working in a loosely structured class entailed another kind of difficulty. He wanted the IT classes to be more tightly structured as other typical college classes were, such as giving small assignments to make sure that students were building knowledge step-by-step.

> I see that there's a lot more freedom basically. We have the freedom whatever product we choose, and we can set out our own deadlines. I'd say people stay to work on their own project, which made it a lot easier, took a large pressure off because we could do whatever we felt would be more interesting. Everything in English is more structured and formal. This course is just more of an experiment..... It might be better if it is not too formal, but enough for us to know how we're doing in the class, with occasional assignments. Sometimes I think it would be easier to have small assignments because we can keep track of our progress.

Larry also felt it hard to work on a paper assignment, where detailed instructions were not given.

> On the paper, the professor didn't give us much guidelines for the paper. So I am really not sure how to approach the paper and that's difficult for me.

Students in their early college years found this flexibility especially difficult. One sophomore student, Taylor, felt that the instructions for a paper assignment were not as clear as the instructions typically given in other classes.

> They [other classes] give you, you need a thesis based on this criteria or whatever. We want it structured this way, and we want you to draw... they will give you what kind of conclusion... you need to draw a conclusion based on this stuff. In this one [an IT class] basically we had to develop our own thesis... like the last one when we interviewed these people, we had to basically draw our own conclusions as to, and come up with our own thesis about what we thought that information technology in the workplace was doing. And in this one, the paper didn't exactly say what to focus on, just said write a paper and draw from the readings.

Such flexible administration may be a necessary choice for IT classes that deal with technology-related topics that are continuously changing. It contributed to students' feelings that IT classes were being administered in a more flexible way. Most students welcomed this style, but some students found it very difficult.

8.3.3 An Advanced Level of Undergraduate Study

Flexible class administration and intimate relationships between instructors and students gave students the impression that IT education was something beyond the typical level of college classes. In fact, several IT classes were being offered at a higher level of an undergraduate curriculum. Some of those IT classes offered at a higher level were even open to both undergraduate students and graduate students.

One characteristic of the upper-level classes was encouraging discussions among students, rather than strictly following a pre-determined schedule. Senior students tended to welcome this advanced practice. Emily, a senior in Psychology, felt that the IT class that she had taken promoted class discussion and was a mix of different components. She felt that a class based on active discussion among students was a characteristic of a graduate level class rather than that of an undergraduate level class.

> I liked the media literacy class because there was so much discussion. It was a good mix of both discussion and lecture. It was like taking information and sharing information with each other and creating, too.

She liked this class because most of her classmates were serious and into the topic and in-depth discussions were going on in the classes.

> I liked that class, because technically it was a graduate level class, so everybody else is really into the topic and there was lots of conversation... something that you don't get from undergraduate classes because [undergrad] people don't care that much.

Emphasis on groupwork was also pointed out as another characteristic that showed the advanced nature of the IT classes. Participants also commented that IT classes had a more project-based curriculum and typically placed more emphasis on group projects. This emphasis on collaborative work was another factor that made participants feel that IT classes were upper level classes. Students pointed out that the disciplinary areas in colleges usually required a lot of solitary work. They contrasted IT classes to those typical disciplinary classes in terms of the weight given to group collaborations. Aaron, a History major, talked about his experience:

> That's what I like about the IT minor, being able to do the group work. In History, most times you write a paper by yourself, and it's like you really don't get to work as much. Aside from discussion sections, where we discuss topics, but as far as group work goes, there's not a lot of group work in my History major.

They generally felt that it was an advanced level experience that they could not get from other classes. Kate said:

> Sometimes... hahaha... I don't normally get a chance to do it [groupwork], so... I know a lot of other people do it, so I think it's a good experience to have.

IT classes often assign group projects instead of tests to evaluate students' learning outcomes, unlike typical classes that use typical evaluation methods of testing. This unique evaluation method for undergraduate students was also pointed out as a practice that showed the advanced nature of the IT classes. Kate continued:

> There aren't tests in these courses. For the most part, it's doing projects, participating, and being a presenter of that day.

Groupwork experience was often valued in terms of its relevance to students' future careers in the real world of work. More and more projects in the real world are being conducted collaboratively at a group level, which in turn made workers' teamwork skills, communication skills and leadership skills more valuable. Students' perceptions reflected this trend. Aaron said:

> A group project is a very exciting thing. We are able to choose a humanities project, and are able to pursue it and present it on a computer. I think that's the most enjoyable part of the class. It allows me to see different aspects of expertise. That's what means a lot to me, to be able to see different expertise, and be able to work with different expertise to pull together a project. That'll be very helpful in the future.

The feeling that IT classes were an advanced level of study was also due to their perceptions that they were learning something important ahead of other people. Participants perceived that the knowledge of technologies was increasingly important for everybody but not everybody had the opportunity to have IT education. This feeling of learning the advanced topics prior to other people in society contributed to their perceptions that IT classes were beyond typical college education. Janet commented:

> I liked the IT classes. I feel like I learned a lot. Like I said before, if I try to talk to my parents or my friends about the stuff that I learned from the minor, they have no idea what I am talking about, so I feel like I do. I have some insight into something totally different about this technology thing, which can be really confusing to some people. For example, my mom, she has a web page. I actually helped her edit some of it, and my parents are really impressed that I knew how to do that, you know, like opening my text editor, and doing how to do that, you know, like opening my text editor, and doing the HTML stuff, most of my friends don't know how to write HTML.

To summarize, participants felt that IT classes were at an advanced level in college, because many IT classes adopted advanced class practices such as discussions and group

work, and because they felt that they were learning something important before other students.

8.3.4 Building on Students' Previous Experiences

Another factor that contributed to students' impressions of the IT program being an unusual opportunity was that IT classes build on students' previous experiences not necessarily obtained from their prior academic training. Participants stated that the assignments of IT classes built on students' previous experiences with IT, in many cases those experiences that they had had outside of their school work. Jack, an Advertising major, found that the upper level IT class that he had taken built less on students' academic experiences through their training in college, but more on students' experiences from everyday life settings. Therefore, he found that the levels of the undergraduate and graduate students' background knowledge were not very different, as the background knowledge did not necessarily come from students' prior academic training. Instead of being separated by seniority, the class had a friendly atmosphere of building a knowledge base together in a close collaboration. He thought that he was able to have a good experience from the mix of students from different levels.

> That's [a mix between undergraduate and graduate students] actually kind of nice. We have some PhD students in our class. Again I thought that it was gonna be a little awkward for me being an undergrad while all of them were much more knowledgeable about the subjects. But everybody's been really nice, everybody made sure you had a lot of knowledge and input, it's been a really nice experience...

Jack's remark was consistent with Andy's comment about IT classes that "there was not a linear progression of classes to go through that build on a formal knowledge base." Jack commented that he realized that the class was a new kind of class in which prior knowledge obtained from his college education did not matter much. It seemed that less importance of prior knowledge from the educational track gave students the impression that IT classes were more suitable for upper level classes, and at the same time gave students confidence that they could contribute to the class as much as the graduate students in the same class.

Being able to draw on their prior experience with technologies was another reason that they liked IT classes. Dave expressed his excitement:

> I feel like whenever she is talking about blogs, or whenever they are talking about anything technology-related, I know about them. I can definitely relate... I was like, "Okay, she was talking about computing, I know what computing is about, when she was talking about editing, I know what he's talking about." I think experience helps, experience really helps with this minor, my experience with computers...

Aaron told about his class experience of developing a class project using his past work experience at a museum. He said he continued his previous project of building a database of postcards at a museum as a class project.

> There are many projects out there that you can do, but it has to be relevant to the course. I still gotta keep in mind as I am doing this project, make sure not to go too far, which is presenting content..... I started to work a little bit of a postcard archive right next to the museum, it's a part of the museum, and they had the filing postcards, and also then I started... they wanted me to help populate a website, they're transferring some jpegs from... they're actually putting them onto their postserv website.

What if the person did not have a previous experience to use for a class project? Having students draw on their own previous experiences for class project made students who did not have such experiences uncomfortable. Lisa, an English major, said that she was not able to contribute very much to the discussions in the Capstone class, because she felt that she did not have as many IT related experiences as her other classmates did.

> Maybe it is hard for me... I may be just pretending to be interested because it's hard for me. But, you know, I found it to be difficult to contribute to the discussions when I didn't have the experience like everybody else did. They brought in knowledge they've gotten from other classes. I didn't have that. Maybe it is sort of... But the classes that were usually undergrad, I particularly enjoyed them, because you're more likely to find people who have all these different perspectives. You're not expected to know, and to have all these experiences...

All the characteristics of IT classes that participants pointed out - unusual topics, different approaches of teaching, advanced nature of the classes, and building on previous experience not necessarily obtained from prior academic training - converged on the students' perceptions that IT classes were more advanced than typical undergraduate classes. These characteristics contributed to students' feelings that the IT program was an atypical type of education in college. The characteristics participants pointed out also suggested that the IT program addresses issues in an intermediate area, between college life and everyday life.

8.4. Summary

Participants' experiences in the IT classes indicated that the most characteristic aspect of the IT classes was their interdisciplinary nature of putting technical components and humanities/social sciences components together. They saw the class discussions that incorporated those two previously separate subjects as the most valuable experience in the IT classes. Participants also saw IT classes as valuable in that the classes exposed them to different technical issues and provided them with opportunities to interact with their peer students with different expertise. This finding has a thread of connection with the findings from the previous chapters, that students' desires to obtain more skills and knowledge in IT is often stimulated by their interactions with peers.

While most of the positive experiences in the IT classes were associated with the interdisciplinary nature of the IT program, problems and challenges that students experienced in the IT classes were also closely tied to their interdisciplinary nature. Many problems resulted from the attempt to deal with technological and social topics together. Skimming many topics in a short period of time, overlapping content among classes, and not giving clear expectations were pointed out as the major problems. In particular, the appropriate level of the technical requirements in IT classes was heavily debated. While students believed that putting technical and social components together was the most valuable aspect of the IT classes, they perceived the optimal level of technical requirements within IT classes differently depending on individuals' technical

backgrounds and interests. It seemed that an appropriate balance between technical and social components was very subjective.

Participants also felt that the IT classes were very different from typical college classes in many respects. They felt that the practices of the IT classes, encouraging discussions among students and between instructors and students, drawing on knowledge from the real world rather than on purely academic topics, and having students work in groups, were all very different from typical college classes. All these characteristics contributed to their feelings that the IT education program is beyond the typical range of undergraduate education. These characteristics imply that the IT program is addressing the issues in another intermediate area, between their college life and everyday life.

9. IT EDUCATION IN A BROADER CONTEXT: IT EDUCATION, MAJORS, AND CAREER CONSIDERATIONS

The IT program in this research setting is currently being administered as an undergraduate minor program. Being offered as a minor implies that students would choose the IT minor to supplement their majors in some way. Findings from the interviews indeed indicated that students found the IT program valuable mainly because the IT minor taught subjects that were not taught in their majors. While this was often the case, the in-depth analysis of the interviews revealed that students' choice of the IT program was more closely related to the career fields that they hoped to pursue, which often did not match up with their majors. In this chapter, students' perceived value of choosing the IT minor is examined first in relation to their majors and career considerations. Then, some important factors that influence students' decision to pursue the IT minor are investigated.

9.1. Comparison of Students' Reasons for Choosing their Major and the IT Minor

9.1.1 Primary vs. Supplementary Choice

Obviously, while participants' choice of their major was a primary choice, their choice of the IT minor was supplementary. Many participants reported that they chose the IT minor because they expected the minor to supplement their majors in some way. Participants who had majors that were more heavily influenced by IT innovations found a more direct relationship between their major and the IT minor than students who had broad majors which have not been influenced by the IT development as much. Students in these majors viewed IT education as very relevant and useful to understand the important changes occurring in their major fields. Those majors included Journalism, Advertising, and Aviation in this study. For example, Abby, a Journalism major, stated that she chose the IT minor mainly because she realized that information technologies increasingly had become the major medium to deliver news. She regretted that the important changes driven by IT were not being addressed enough within the Journalism field. Abby stated:

> I was looking through the web pages of what I could minor in, and I saw this one, and I thought it was relevant to my major. I feel like it complements my major, Journalism, as where the technology of journalism is going, and what new mediums will be using to portray the news. I do think they are hard, and I know I haven't understood everything they said, but I think overall I have a much better grasp of technology than I did..... For Journalism, with all these new forms of media, Journalism isn't just newspaper obviously, I think it's relevant to learn different media. If our job is to provide news to the public, then we need to learn how to provide the news in whatever form that technologies are taking us.

Similarly, Jack, an Advertising major, had realized that many key changes in the Advertising field were driven by IT. He pointed out that the biggest challenge in the area of Advertising was the transition of advertising platforms, from traditional media to digital media. Therefore, he thought the opportunity for IT education would help him deepen his understanding of the transition.

> I do think one of the big challenges coming up is the clash between the traditional media and the digital media. We've talked a little bit about how magazines and newspapers, the leadership has been declining, where the Internet has just exploded. But as an advertiser, how do you let go of such conventional means and the people that basically read the NY Times and read the Chicago Tribune, and also respect the people who are going online as well with the same budget. I think that's gonna be challenging, this transition to digital media.

This realization of the significance of IT, which he had not had before college, developed while he participated in various activities in college. This has a thread of connection with the findings in Chapter 5, which described the changing meaning of computers as they enter their college life. Earlier in his interview, Jack indicated that he did not even know in his freshman year if Advertising was a field that college students could major in. It was only after he entered college that he realized Advertising was an area that students could major in, and was an area that was experiencing significant challenges due to technological innovations. Jack pointed out that his awareness of this significant transition particularly grew out of his advertising experience in a student organization

that he belonged to. The platform of the advertising activities was Facebook, a popular social networking technology. The awareness of potential applications of technologies for advertising activities made him pay attention to the IT program.

> Just through "Star Course," [the name of the student organization that he belonged to] I am responsible for doing all the advertisements and managing that budget, we have actually had a lot of success having free events on Facebook, as opposed to a lot of print-ad and we've actually created Facebook events what they called, so you fill in the date and time and a little bit of information about the concert, and then you can actually post that to your different friends and have them post it to their friends, and it's kind of viral marketing. It has worked very well.

Other participants also pointed out that their major fields were being heavily influenced by technological innovations. James, an Aviation major, mentioned that he became interested in the IT program because he felt that it was very relevant to his major, as more and more technologies were being adopted in the Aviation field. He was hoping to become a pilot, and emphasized the relevance of IT minor to his training based on the fact that an aviation cockpit was increasingly full of information technologies.

> Information technology sounds like... really good, sounds like something that somebody in aviation would be looking for. There's a lot of technology in a cockpit.

As shown above, students from majors that were being more heavily influenced by IT chose the IT minor based on the recognition that technological innovations were the main factor that had brought significant challenges in their areas. As their study in college and their future plans were well-aligned, they saw the relevance of the IT minor to their majors positively.

While some majors focus on relatively well-defined professional fields, other majors are more academically oriented and do not have a strong association with specific professional fields. These broad majors include more academically focused majors such as the Humanities and Social Sciences. Also, these majors have been relatively less challenged by technological developments. Participants who were from these broad

majors tended to focus more on the relevance of the IT minor to their future career fields that they desired, rather than on its relevance to their current majors themselves. English majors who were most numerous in this study had typical career concerns of such broad majors. For most of these English majors, IT was not so much related to their academic interests in English as to their practical concerns about their future career plans after graduation. Their purpose of taking the IT minor was more to make up for the lack of professional training in their major fields and to build a more focused foundation to carry on important tasks in their future career, rather than to deepen their understanding of their major field. For these students, their study in college and future plans were not as tightly associated as for other majors that were more closely related to specific professional fields.

Participants who had this type of major reported that they were experiencing pressure from the job market to specialize in some areas within or outside of their current major in order to make themselves more suitable for the changing workplaces. This feeling was well expressed in Kate's statement.

> I feel like especially a major like English, you have to develop your own specialty or look for opportunities outside of that major, because it's not going to be, unless you go on to grad school, it's not gonna lead you to anything practical. Like you are gonna have to look for an internship in summer or something like that.

Pressure to specialize in something outside of their major was expressed by two English majors, Janet and Jenna. Janet realized the practical difficulty of getting a job as a Humanities major, after watching her friend who was a math major with a business minor get a job much more easily than her. Therefore, she saw the value of the IT minor as adding some specialization to her broad major, which would make her more attractive in the career field that she was pursuing. Janet stated:

> One of my best friends, she is a math major. She is having a much easier time getting a job. But she never had a job during college, while I always worked... I worked for the Yearbook, I worked for the industry that I want to go into, but she didn't ever have a job. But she found a job. She is in the business minor. But it's also... I feel like... it's the way school is designed. They help out people in

> business and engineering a lot. But people in English and Communications, not as much... hahaha...

Jenna, who wanted to find a general office job in the business field, pointed out that just being an English major would not differentiate her from many other students in the field. She expected that her IT minor would demonstrate her unique experiences with computers on top of her study in English to future employers.

> I am looking for an internship, and it's a finance company. It's mainly all business. Being an English major, it would be kind of difficult for me to get into that company just being an English major. But the fact that I have a minor in Information Technology Studies really helps, because it shows that I have experience with computers in that aspect and actually I just got an interview today, and for next week. So... I think that it really helps me out because I don't think they would hire a person who is just an English major for an internship.

The focus of specializing in a specific technology-related subfield was expressed by another English major, Larry. The reason that Larry chose the IT minor was to be able to work in a specific IT-related sub-field within the broad writing career field. He had a concentration in business and technical writing, and hoped to become a writer who would write about different technologies. He thought that taking the IT minor was a good idea to prepare himself for the specific field of writing about technologies. Now he changed his path to go to a law school. Still, he thought that the IT minor was a good fit for him because he wanted to specialize in an IT-related legal area, such as cyberspace law. His case showed that students' hope to specialize in a technology related sub-field within a broad area was a strong motivator for them to seek an IT minor. Larry stated:

> One of my previous goals was that I could write about IT. Or, perhaps like for journals or magazines about emerging IT... but that seems like a really hard field to get into. It's just... I am going to law school, and I am planning on doing something very related to IT, or technology in general, maybe not intellectual property, but maybe something like cyber law...

As shown so far, the perceived relationships between students' majors and the IT minor were all different depending on individual students' circumstances. However, the good

news was that regardless of the reason, students found that the IT minor also helped them deepening their understanding of their major fields. As a Political Science major, Andy had specifically expected the IT program to be supplementary to his major. He was initially attracted by the technical aspects of the IT minor, and hoped that the technical stuff that he would learn in the IT minor would make a good contrast to his major. However, after taking a few classes in the IT program, he commented, the IT program turned out to be not only supplementary to his major, but also complementary to his major, in that it helped deepen his understanding in many topics being intensively discussed in the Political Science field as well. He also appreciated what he happened to obtain from the IT minor program, practical applications of his computer skills for his future life. His statement indicated that students might not be able to anticipate exactly what they could obtain from the IT program. Sometimes students realized the worth of IT education after they had experience with it.

> I'm glad that I have been enrolled in the minor. I am glad that I have taken it. It has deepened my appreciation for maybe what I want to do after college. I was initially looking for something supplementary to my studies, but it turned out to be complementary, which is fine, which adds to my skill set, and the knowledge base that I suppose I desire, and almost likely will draw upon after college.

9.1.2 Interests and Talents: "Because of" vs. "Regardless of"

Overall, the reasons that participants chose the IT minor were markedly different from the reasons that they chose their major. When choosing their majors, their interests and talents were students' primary considerations. For example, students chose English as their major because they were interested in and good at writing. Engineering majors chose Engineering because they were a "science kid" when they were young. In contrast, many participants in this study indicated that they chose the IT minor regardless of their lack of interests and talents in the IT field.

Participants' top consideration in choosing their major was their level of interest in the subject matter. Some students chose their major because they had had an inherent interest and passion in the subject field since youth. For example, Chris described how his early excitement about computers influenced him to choose CS as his college major.

> When my parents got me a computer when I was little, I thought this was the most amazing thing in the world, because I could immediately see how this could be translated into, being 13, I was like "This can be used to make computer games, Awesome!" That's what drew me to do that. Exactly one year later, that's exactly what I was doing. I was using programming languages like Q-Basic, Python, and C++ to write these basic computer games with these old programming languages. Because nobody told me what I could or couldn't do, I did what I realized now is crazy stuff. I built this one computer game, which involved this particle simulation. I thought this was straightforward when I created these little games, and I had no idea that these were very difficult industry problems, that current computer gamers really haven't solved yet. When I showed this program to people at my school, at my high school, they immediately suggested that I start the computer science program, and I got into programming that way. And that's what really led me to CS.

Examples in which early interests developed into students' choice of their college majors were most frequent among engineering students, but some students from other majors also reported a similar experience. An English major, Claire, said that she had had such a deep inherent interest in English since she was young, and choosing English as her major was not even a choice to her.

> It [choosing English major as my major] doesn't even feel like a decision to me. Just kind of given for me. I didn't really take any consideration what kind of job I could ever get with it. Just that English is my obvious area of interest, so I majored in it.

Passion in a field was a major reason that students continued to pursue their major in spite of some difficulties that they encountered in their majors. As Abby stated:

> I think it comes down to what you are passionate about and what you enjoy doing, because I think a lot of people would say that my two reporting classes are intense and hard, which they are, but to me they are not, because I like going out and interviewing people and I like writing. But I know some people when they see the syllabus and see what I have to do they say "it's so hard, I can never do this."

However, these considerations of students' passion and interests in choosing their major were a contrast to the findings reported in the later part of Chapter 7, which showed that many students had practical considerations in joining the IT minor program. Many participants did have broad interests in different issues of IT, but the motivating factor that made them actually take the IT education opportunity was their various practical considerations rather than their passion.

The second big consideration in choosing their major was consideration of their talents. Considerations of what they were good at was another main determinant in choosing their major. Larry, an English major who had a Business and Technical Writing as his specialty area, said that because he was good at writing, he thought it would be a good idea to choose a writing-related major over other majors. His counselor's suggestion about utilizing his talents in writing also played a role in making his decision.

> I chose English as my major because I found I was good at writing. I considered a lot of majors, but the problem was, when I narrowed it down, this was the best one for my capability. The counselor in the general education department said I did better in writing courses than I did in science courses, so that's why she suggested Business and Technical Writing.

Ricky, a Chemical Engineering major, explained that the reason he had chosen Chemical Engineering was that he always had talents in math and calculus. Since he was young, he had been much better at learning the fundamental science principles than doing writing. Hence, choosing a science field was a natural choice for this "science kid."

> I am generally good at math and calculus... I am fairly decent in it. That's why I went to Chemical Engineering. They knew that I always have been a science kid. It naturally fits with my talents..... I've always had issues in writing papers because I am slow at it. That's primarily why I chose math and sciences because I am quick at it. I can write a paper but it takes me a long time to come out with the material.

Considerations of their own talents in choosing a major were obvious in the participants' descriptions of the in-depth exploration of their own talents involved in their decision

making processes. When evaluating their talents to choose their majors, students weighed what they were good at and what they were not good at very carefully. As Abby stated:

> I didn't like math. I didn't like econ. I didn't know what I wanted to do. So it made me think business is not a major for me. And I am good at writing. I am good at taking pictures, and I decided I should go to Journalism.

However, the decision making process involved in choosing the IT minor was a contrast. As Kate described her motivation to take the IT minor, students indicated that they chose the IT minor regardless of their lack of talents in understanding and dealing with technologies. Throughout her interview session, Kate stated that she was not good at dealing with IT but she needed the IT education because it was important for her plan of becoming a librarian.

> Actually I just wanted to take it [the IT minor] to help me with grad school, because I had to know how to do HTML programming last semester in a group making a web site, and I just had no idea how to do it. I don't know if I want to [learn about IT]... I have to. I should...

As seen from all of the above examples, students' main considerations in choosing their majors were their interests and talents. In contrast, their primary considerations in choosing the IT minor were their recognition of the overall significance of IT and practical value of learning about it. These students decided to pursue IT education regardless of their current level of interests and talents in IT.

9.1.3 Career Considerations: Vague vs. Focused

Career considerations were an important factor in deciding both students' majors and the IT minor. However, career considerations were differently involved in students' decision making processes of choosing their majors and the IT minor. Career considerations, not unexpectedly, were one of the main determinants in choosing their majors. However, career considerations at the time of choosing their majors were not very clear for many participants. Considering that most students had to choose their majors in their first two years in college, it was not surprising that career considerations involved by that time were often not very clear. It was normal that students often went back and forth between

their unclear career goals when deciding their major in their early college years. This was more apparent in the experiences of students who had broad majors such as English. Janet's experience exemplified the early uncertainty:

> I chose English because I wanted to be a high school English teacher. But then my advisor told me that if I wasn't 100% sure if that's what I want to do, I shouldn't do it. So I ended up changing my major to Psychology for a little bit, then I changed to Political Science for a little bit, for about a week, and then I ended up with being back in English.

Some students even mentioned that they chose their majors just because they had to choose a major, without having any serious career considerations. This was especially frequent for the Humanities and Social Sciences majors. These students started to worry about their careers in their late college years. Emily, a Psychology major, said that she chose the Psychology major without much consideration of what she would do with that major later. At that time, she just had to choose a major to graduate on time and nothing else interested her. She did not know what she wanted to do at that time, and chose a broad major to have open possibilities for different career paths.

> I came here undecided and I became really interested in Psychology after I took a Psych class. I had to declare a major, and there wasn't anything else that I was that much interested at that point. I think I heard about the IT minor from the Career Center actually. I am really glad that I majored in Psychology, because it's a good background for anything. But I didn't have any specific career goals in mind. So it's just like, or, I have to declare a major, I had to choose Psychology, because I've taken more classes in that than anything else, and it's really interesting. And my career goals are not directly related to Psychology, but I still feel like it's a good background.

It was common that those students confronted the practical difficulties of getting a job only after arriving at a later stage of their progress in college. Lisa, an English major, had been an Astronomy major at first. She switched her majors after realizing backyard astronomy was different from professional astronomy. However, Lisa had a similar feeling about her education even after switching to English. While exploring possible

career fields, she ran into the IT minor which was being offered as a Library and Information Science minor at that time. She chose to take the IT minor because she thought that librarianship could be a possible career field that she could choose.

> I didn't know what I wanted to do with my life until I entered the college. And I had different expectations about what I would do. With like astronomy, I thought it would be really interesting, and amateur astronomy, or backyard astronomy is kind of interesting, but doing it as a professional level is so much more technical, and it's not always exciting. I just don't think I knew what I wanted when it was time to choose a major, and then once you're into a certain grief, you feel like, "I have gone so far, I turn around now..."

To these students, the IT minor came to attention in this realization of limitations of their majors. The IT minor was perceived to be a means to make their job qualifications more focused. As Jenna indicated:

> It [English] is a really broad area, and it's hard to narrow like when you want to find a job, what you are gonna do with an English major, because it's not really something that, I mean, you can teach English, but it's kind of hard to find an area of expertise to settle into. I think that's the worst thing about it.

As implied from the above statements, the timing at which these students considered the IT minor was when they started to think seriously about their future careers and realized some limitations of their broad majors in pursuing them. Meanwhile, students who had more professionally-oriented majors were relatively indifferent about the practical value of having the IT minor. Participants who were already in majors targeted to well-defined professional fields were less attracted by the IT program. In this study, students from majors such as Accounting, Finance, and many engineering fields, showed less interest in the IT minor program itself, regardless of their manifestations of interests in many topics of the IT field. This indifference seemed to be due to the fact that they already knew which career paths they would follow. The indifferent attitude toward the IT minor that this type of student expressed was additional evidence that the IT minor sometimes had a practical value of focusing down their job qualifications.

In addition, participants commonly indicated that having the IT minor could be a demonstration of their well- roundedness. The focus of the IT classes widely ranged from social to technical. Depending on the classes that they choose, the IT minor could be either more social or more technical. Students in the engineering fields could show their well-roundedness by taking the IT minor classes focusing on social aspects, and students in Humanities and Social Sciences could do so by focusing on technical aspects. Therefore, the IT minor was perceived as a good means to demonstrate their well-rounded experiences.

The timing that students make a decision to pursue the IT minor has an implication in administering the IT minor as well. To pursue the IT minor, students should have enough time left to fulfill all the minor requirements by the time of their decision. Therefore, one implication that can be drawn is the significance of advertising. It is important to let students know early about the availability of the IT minor on campus. Aaron commented that when students feel the needs for learning IT, it may be too late to join the IT minor. He suggested marketing should be made to freshmen, so that they can start the IT minor in their sophomore year. He pointed out a need for early advising, because it might have been late to start the IT minor when a student found out a need to learn about IT. Aaron stated:

> With the IT minor, I could have started this minor early in sophomore year. It would have been more appealing. Maybe more posters and advertising, demonstrations to freshmen at the dorm... maybe previewing a couple of courses might inspire more people to come. Maybe if there were some examples, or maybe taking some projects that we have already done, or maybe having a couple of students who were in some of the classes talk in the dorms, show example projects what they worked on... I think that's the biggest thing.

To summarize, students' choice of IT minor had different reasons from the reasons that they choose their majors. Overall, students' choice of the IT minor was more focused and goal-oriented than their choice of majors. Choosing a major usually comes first, and choosing the IT minor comes afterwards with various other considerations. One obvious finding is their realization about their future career, which had not been so clear in their

early college years, comes into play at a time that they choose the IT minor. They choose the IT minor as a strategic move towards making themselves more adjustable to the real world.

9.2. Career Considerations in Students' Choice of the IT Minor

In the previous section, it was demonstrated that students' choice of the IT minor was closely related to their practical considerations in the process of thinking about their next step through their progress in college. In this section, those practical considerations involved in their choice of the IT minor are explored in more depth.

9.2.1 Career Interests

The instrumental/practical value of IT that students had expressed was in many parts related to their career interests. They wanted a free rein from their future work, and took competency of dealing with IT as a means to get such a job. For example, Kelly wanted to become a librarian. She was confident about her decision to become a librarian, and emphasized that she wanted to be a librarian who plays active and self-directed roles in that field, rather than being library support staff who performs routine tasks.

> I don't want to be support staff, I want to take more active role in libraries. I want to be at a reference desk, I want to know how to catalog, and I want to have the degree that says I can do it, rather than having someone over my shoulder teaching me.

A major hope that Engineering majors expressed was understanding the contexts of their work. Nathan, a Computer Engineering major, wanted to understand why he was conducting his engineering tasks. He wanted to understand the context of his job. He believed that if he could get a better understanding of the contexts of his engineering job, that would eventually be beneficial for his progress in that field.

> You're just told, "all right, I need you to make this. You don't necessarily understand why, just do this, you don't really need to understand what the real purpose behind it is going to be. You are the person in charge of writing me codes for." And so, having a better perspective on what these tools and utilities actually

> are going to be used for and on how people are going to be more effective by using them, I think it really would lead to a big improvement.

At this point, many students' job interest was idealistic rather than realistic. Most of them wanted some free rein of work, with which they could utilize their time and scrutiny at work on their own. This hope was apparently expressed by Ricky, in his comparison of his two past summer work positions. He liked the one in which he got more freedom and autonomy much more than the other one in which he had to perform routine tasks of moving parts.

> I got more free time, free rein of my work, because I would assemble circuit boards according to my desire, my way of doing it, as opposed to moving something from one side of the board to another side, repeatedly.

Aspiration for such jobs that would allow individual's discretion and autonomy was also apparent in Jack's statement:

> My dream job is the Ad department at Google. I hear that they [workers at Google] don't really treat it as a 9 to 5 job that's really boring, sitting in your cubicle, but it's a lot of fun as well, I think that's really important for your work.

Although they vaguely felt that being well versed in IT was an important prerequisite to carry out such creative and autonomous endeavor later, their understanding of the relationship between IT and work was not very sophisticated. For example, many of them still viewed that jobs that involved intensive IT use were some technicians' jobs. Participants indicated that they wanted more people-involved work, taking IT involved work as solitary work. As Lauren stated:

> I prefer a job that does not entail a lot of IT. I prefer a job that is more people-based, or research-based, rather than technology-based.

Jobs that involve IT actually vary on widely different levels. At a higher level, use of IT means having autonomy at work. At a lower level, use of IT means more controlled work. However, many participants' understanding of the relation between IT and work was not very sophisticated to tell the difference among those different levels of jobs. They

recognized that use of IT at work had some relationship with the types of tasks that they would conduct, but the recognition was not very detailed.

9.2.2 Perceptions of the Job Market

Job interests were not the sole factor for students' career considerations involved in their choice of the IT minor. Their career interests should be negotiated with the knowledge about the external job market conditions. Most interviewees felt that the job market's skill requirements were becoming more intense. Therefore, they indicated that they were trying hard to find a way to set themselves apart from other job applicants who had similar qualifications. Many students were pursuing the IT minor for the purpose of making them unique in the competitive job market.

Jack described his nervous feeling about getting into the competitive advertising job market.

> I actually heard an interesting statistic from one of my Advertising professors, that says for every 14 advertising majors there is one advertising job, so it's very competitive. And I know a lot of seniors right now that are very stressed because they currently don't have a job lined up, but that's also very normal in the advertising industry. The advertising industry from my understanding doesn't rely on basically having a fresh bachelor's graduate coming to the workforce, instead they consistently are looking for people throughout the year, so a lot of people I know who also previously graduated didn't have jobs lined up until after they graduated. So it's kind of up in the air for a while for them.

The requirements most frequently perceived as demanding were work experiences. Many students felt that they were disadvantaged compared to their competitors who had much more work experiences. Many interviewees recognized that work experience was strongly required in addition to their education, even for fresh college graduates.

Many senior students felt their lack of enough work experience as their serious weakness. Especially students in the Humanities and Social Sciences regretted that they had not realized the importance of work experience until they were close to graduation. Lauren, a

Sociology major, regretted that she should have had jobs that build experience, rather than money. She said that she realized it only recently.

> I don't have enough work experience... as a Sociology major, there is not a lot of... I was not advised a lot of internships that I probably should have jumped on. If I had internship experiences, that would have made this process easier.....Maybe I should have taken less paid jobs or internship, instead of those jobs [daycare, recreation leader at parks], because I had the jobs because I needed money, they weren't really, they wouldn't give me any qualifications.

Obtaining good IT skills and knowledge through the IT program was perceived to be one way to make up for their lack of work experience. Janet continued:

> And I actually have been looking at requirements for a variety of jobs, and good computer skills is a good qualification. I mean, I have good computer skills, but even better computer skills, and internet stuff. They do ask for HTML, so getting a better handle of that would be probably helpful.

Because of those concerns that they were not well-prepared for the ever intensifying job market, many participants stated that they were trying to make themselves as unique as possible. For many participants, choosing the IT minor was one such endeavor. Aaron believed that his IT minor, on top of his History major, would make him more appealing in the job market.

> I guess the biggest thing is to try to make myself as unique as possible and stay optimistic toward the field. I guess that's why I started with volunteering at a library and a museum. I wanted to start building some experience in the field so that I can have something extra to put down on my resume. I think it is an important thing in building a strong resume.

9.2.3 "The IT Minor is My Edge"

Along with the concerns that the job markets were getting tighter, many participants took the IT minor as their significant edge. Earlier they indicated that they considered what was being taught in the IT minor was important to anyone and that everybody would need to acquire that knowledge. They felt that they had an advantage over other people

because they had obtained that important knowledge through the IT minor earlier than other people.

Abilities create digital artifacts with computers were perceived to be an edge especially in comparison with older generation people. Abby stated that it would be a significant edge over older generation people.

> I think a lot of older people don't have this [IT education], and when they see a younger person who is not only a writer but also has technical skills, that makes you much more valuable.

This intention of getting an edge through the IT minor was more clearly expressed by the participants who were pursuing their future career in the fields that were more challenged by technological innovations. The library field was a good example. Emily was pursuing librarianship after graduation. She perceived that her IT skills that she had acquired from the IT minor would give her an edge in pursuing librarianship.

> Obviously engineers and CS people have more IT skills than I would have, but general humanities majors, I feel I am much more prepared... The IT minor is definitely a point that I would use to sell myself... "I have experience in webpage design, and I understand about technology issues that we face today. I am good at finding information."……I will be able to market some of the skills that I have had, such as HTML design, or knowledge of CSS, and some knowledge of PHP to probably get a job. I don't know where exactly that'll be, I am sure that I could find a job somewhere doing something and be able to use the skills that I have learned and use that to get a slight edge over other employees.

Kelly chose the IT minor because she felt that graduate library schools wanted to see something different while everybody else had background in history and literature. For her, IT education was an unusual education opportunity that would give her an edge over other students with similar qualifications.

> Having any sort of IT competency is gonna put you so much higher in the rankings as far as finding positions than anyone else.

If not intentionally trying to acquire IT knowledge and skills for their possible instrumental value of landing a good job, students still thought that IT knowledge and skills would be advantageous for them in their future career fields. Dave thought that his specialization in IT would place him higher among other people who were also pursuing a government job.

> I'll be able to, as far as the technical aspect, understand databases, how people share information, I feel like I have an edge over that. I think having the GIS thing on my resume is huge. It'll give me some edge. It'll tell that I can run this program. Whereas in Political Science, we're learning about how the government works, I have an understanding of the program that they are going to use...

Most students believed that the IT minor would make them unique among students with similar backgrounds and qualifications. Abby said that many Journalism majors had not realized the importance of knowing Web technologies. She felt that by learning technologies, she would be able to do some things on the computer while other people would not, and that would give her an edge over other people.

> I think some Journalism majors would have no idea just how to make a basic HTML page. I think it might be helpful in my job if I was a journalist and I knew how to do certain things on the computer that other people don't, then I think it would be definitely a plus.

Chris believed that his combined education in IT and Philosophy would take him to a more advantageous position in his future job than simply being a CS major.

> Having that kind of education in the form of IT minor, combining with philosophy education, the logic and reasoning aspect, knowing how underlying computer systems work, I am in a better stead than I would be with a CS degree.

One noteworthy finding was that participants took IT knowledge as valuable add-on knowledge, rather than as a fundamental knowledge base. Janet felt that technical knowledge was useful extra knowledge that employers would find value from.

> They [employers] would look highly upon somebody who has extra knowledge about technology. If you have extra, they are always willing to take those. I have

more than anything if I have better computer skills that the person who interviews for me, that's good for me.

Participants felt that IT knowledge was valuable extra knowledge to their own expertise built through their training within their major fields. They felt that IT knowledge was like "icing on a cake," on top of their competencies in their own expertise area. IT knowledge is becoming important to everybody but is not something that everybody has. Students felt that they would get advantages by getting the important knowledge before other people acquire it.

9.2.4 Students Pursuing an HCI Position

Chapter 7 suggested that the hallmark of the IT education field may be human computer interaction (HCI) that is more broadly construed. It was pointed out that "how humans and computers interact" was a symbol that characterized the field of IT education. Some participants in this study showed interests in finding an HCI position as their possible future career choice through their training in the IT program. It is good that students recognize the importance of the HCI field and regret that this field has not been given as much attention as it deserves. However, these students need some guidance, as the HCI field is not defined well as a unique professional career field as to provide college students with exact directions of the paths to arrive at them.

Chris' reason for doing the IT minor was unique, in that he had an obvious intention to work in the HCI field. He started college with a CS major, as he had a lot of computer programming experience since he was young. He found that he could not find one single major that satisfied his unique interests in HCI. Chris found that a combination of Philosophy and IT would be an ideal preparation for his graduate study and future career in the HCI field. However, considering a report that most HCI positions are filled with technical people who have lots of work experiences rather than college graduates who are fresh out of school (Whitaker, 2007), it seems that students who have a specific interest in this career field needs a careful guidance.

> So I switched [from CS] to Philosophy, with the IT minor, and the rest is history. In fact, I would probably be doing an IT major, with the Philosophy minor, if the university offers that. But I don't think that's currently offering. But that's okay,

> because I am still an undergraduate, so if all goes well, I mean, the future isn't written yet, I might be considering a heavy focus on IT in my graduate years....Again, it's another reason why I found IT and Philosophy to be the ideal system for me. Because I was able to combine my ability to write and use the communication to describe my education in technology... So the combination of the two really worked out very well.

Considering that much of the training for HCI jobs is happening in the workplace, students who come to the IT minor with a consideration for HCI jobs should be advised carefully. Whitaker (2007) reports that HCI positions are increasing, and those positions are currently being filled with experienced IT people, and reports that universities are increasingly teaching HCI-related subjects. If knowledge of HCI, as the article argues, is a type of meta-cognition about computers and human usage of them which is attainable through a significant amount of practical experience with computers and users in the real world setting, how can it be taught in colleges and how can students be guided into that career field? This may be a consideration that educators need to make if students perceive the IT education field as a broadly construed HCI, as reported in Chapter 7.

9.3. Competing Student Opportunities

Unlike students' majors, a minor is optional. Also, as demonstrated in the previous section, the IT knowledge and skills were perceived as valuable add-on knowledge to their expertise in other fields. Therefore students' choice of IT minor was competing with students' other valuable opportunities for their time and efforts. To promote this unique IT education opportunity, it would be necessary to examine other opportunities that the IT minor program is competing with. The interview data showed that students' schedule was full with classes and activities significant for their social life and professional development such as internships, study abroad opportunities, and an honors program. Many activities that they were engaged in were for fun, but many others were for their career management.

Jack, who was actively participating in a student organization, stated that balancing his course load with his club activities for his advertising experience was his biggest stress.

> I am actually involved in several RSOs [Registered Student Organizations] as well. In the advertising major, there is an organization called "Star Course," and it's completely run by students, we just have book shows, concerts to come to Foellenger, so we have two shows... one show coming up on Sunday, and one a week and a half from Sunday. It's been a lot of work... so..... It is exciting but it is a lot of work to do with right before the show. But I think it's really fun..... It [Activities in RSO] is definitely a mix of for fun and for experience. All of my really really close friends on campus I've met through this organization. So it is really good to go out and see everybody there... at the same time working with big advertisers to get radio spots made and to get the print ads made, getting my budget approved by the director of Assembly Hall and the different Star Course managers, so there is a definite professional side to it as well.

As the IT program is being offered as a minor, requirements of different majors influence participants' intentions to take the IT minor. Different major fields have different requirements for credit hours. If their majors require many credit hours, students would find it hard to pursue the IT minor regardless of their interests. Ricky, a Chemical Engineering major, has explored possibilities of doing a minor, because he thought having a minor would allow him to have a broader range of experience than just having a major. However, he found that it was very hard for Chemical Engineering majors, because Chemical Engineering required many credit hours to graduate and did not leave much room for students to do anything else.

> Chemical Engineering requires 120 hours worth of credits to graduate. I don't have a lot of free time to get in, all these extra classes, and all the minors. I looked at the requirements, classes that I am already taking as a part of my major, that sort of limits it down, so it makes a lot harder to choose a minor in that kind of field.

Rachel, an Accounting major, originally took an IT class with an intention to pursue the IT minor, but later she decided to drop the IT minor, as she got her dream internship opportunity from one of the top accounting companies.

> Originally I was looking for a minor to take. I was looking at different minors and looked at this one, ITS minor. I was interested in it and I thought I would take the first course and see if I would like it. Instead what I am doing now actually is I got an internship for Spring of my junior year, so that takes all my time away. Actually I won't be on campus so I don't have time for a minor anymore. But originally I was looking into the IT minor.

Another valuable opportunity for students was a study abroad opportunity. The value of having a study abroad opportunity is growing in the ever more globalizing world. Janet said that she took a study abroad opportunity over internship, even though internship experience was also valuable.

> I haven't had an internship. I would have done it last summer [summer in her junior year] but I studied abroad instead. I figured I can either get an internship or study abroad, I don't have many other opportunities to study abroad after college. So I chose that.

Joining in a campus honors program was perceived to be another such valuable opportunity, which could demonstrate their dedication to their academic training. Eric was doing an honors program along with his major and the IT minor.

> For the most part because James Scholars receive a priority registration. I was able to sign up for classes even as a freshman I was able to enroll in classes before seniors had access. So it's a huge perk. Plus, it looks great on resumes! It's just another honor that I can add to my records.

Also, participants placed different values in different aspects of college life. For Dave, getting a high GPA was most important. He decided to take fewer classes a semester, because getting a high GPA was more important than being on time to graduate college. Keeping up with other people in their major was important to Lauren. She said that she

was hesitant to add other things like learning technical things because she felt that keeping up with other people in her major was more important.

Seeking his personal interests was also important to Zachary. Pursuing music and studying Swedish was his personal passion into which he would be willing to put more time and efforts.

> How I am different from typical CS majors... I have an interest in music. So I took two semesters of music theory, and two semesters now of electro-acoustic music. That has actually been helpful for me, because I met some game builders there. And I am also working on two other games for other courses. And I made sound effects, using the stuff that I've learned in my electro-acoustic music courses, where it's basically sound design and sound engineering... if I apply for a game company, I can say, "Hey, hire me as either a programmer, or a music guy. I can do both. Like sound effects or whatever." So it's just one more thing that I can get hired for, but it's still second on the list.

Unlike choosing their major field, enrolling in the IT program to pursue a minor is optional and competing with other opportunities. Besides, the IT minor requires a greater commitment than the competing opportunities, as it requires a certain amount of coursework over a period of time. Therefore, students must have enough reasons to justify this commitment to pursue the IT minor. The findings in this section suggest educators interested in IT education should consider students' other opportunities outside their major, as students determine the value of the IT minor in comparison with other value adding opportunities.

9.4. Other Stakeholders' Awareness

Students' decision to choose the IT minor was not made solely by students' own interests in IT. The interview data strongly suggested that what other people think about this minor had a significant influence on students' intention to pursue the IT minor. Advisors, future employers, and their peers were pointed out as the influential figures.

9.4.1 Advisors and School Administrators

Many times participants learned about the IT minor from their advisors or counselors in their major. They usually followed their advisor's suggestions when they needed information about their career options. It meant that those advisors' awareness and understanding of the IT education program would play a critical role. What value the counselors see from the IT minor and how they advise students about the IT minor may influence students' decision significantly. Larry said that he decided to pursue the IT minor after his counselor suggested having heard about his future career plan in the technical writing field.

> My English counselor who was in charge of the technical writing program suggested that I look at the IT minor. He said it complements business and technical writing background very well. I took his advice on that.

Jenna, who pursued a general office job, also followed her advisor's suggestion when choosing the IT minor.

> My English advisor, he suggested it. I asked him, because I didn't just want to major in English, I wanted to, I asked what would be something good to minor in that would help me find a job after I graduate. He said, "I think that the IT minor is really good for you because it gets you into classes that you really aren't taking now, that are unlikely that you are taking." And he said that a lot of companies are looking at information technology because it is essential to their companies now. So he said that would be good.

Some advisors were not aware of the IT minor at all. Some participants described the difficulties they had, because their advisor did not know what the IT minor was. Lucy said:

> I think a lot of people even don't know about it. I don't think... like my counselor has never brought it up. I have never seen really anything about it, I found it [the IT minor] literally by accident...

She suggested that the IT minor should emphasize its utility to different types of students.

> When they hear about "Information Technology Studies," I think a lot of people will be like, "What does that even mean?" I think, more advertising, in a way that it sounds useful to people, because if you just say "take the IT minor," people might be "Why? What is that?" you know, what is that gonna do for me or what does that even mean. I think what would be helpful is you're getting technical skills that you can relate to a lot of LAS, humanities type of major, show more connection between what the minor does, what it could do for people."

When advisors do not know about the existence of the IT program, their lack of awareness also could cause many other practical difficulties to students. Abby talked about the difficulties that she had, due to the fact that her advisors did not know about the minor. When she had problems with getting credits for the IT minor, she had problems with her advisors in her major as well, because the advisors were not aware of the IT minor.

> My advisors here on campus, they are generally really knowledgeable about what minors are offered, and I don't think they have never even heard, they don't even know anyone in this department. I think this is a great minor for communications majors, or for English majors, Psych majors, and especially Communication majors, when it's all about communicating technically, but nobody knows about it.

She also added that people at her part time work at the school newspaper were very interested in the topics that were being dealt with in the IT courses but were not simply aware of the minor, partly because their advisors did not know about the IT program.

> A bunch of people at the [the college newspaper where she works], they are interested in Java or putting things on the Web, maintaining the Web pages, about the interface of it, like how horrible it is, but they have no idea. They have never heard about the minor. So I've been telling them about the minor, but their advisors haven't told them, and they don't know anything about it. I think it should definitely be pushed more.

Administrative confusion would be a worse consequence when school administrators lack awareness of the IT minor. The confusion was because of the unclear existence of the IT program on campus. Abby, a Journalism major, described an instance in which she heard

that she could not get credits for an IT class which was cross-listed as a Communications class, because an administrator in her program counted it as a Communications course.

> It was confusing because 201 and 491[courses in the IT minor] are cross-listed as Communications courses, which they're saying that I can't get credit. What's showing up on my DARS [the undergraduate academic progress report on campus report] is, as being communications credits, and they can't count it toward the minor. So it's kind of a mess.

The above findings suggested that raising awareness and dealing with their stereotype about IT that advising people may have was very important, both to help students became aware of their opportunities and to reduce practical difficulties that students might experience.

9.4.2 Future Employers

Participants frequently reported that the IT minor was their edge for the careers that they were pursuing. As such, future employers were frequently pointed out as influential figures. Yet, students were not very positive if future employers would know about their IT education. Some of them even thought that IT might be just jumble of letters for potential employers.

> I think, a lot of potential employers will just see that [the IT minor] as a jumble of letters, and possibly just ask you what is that because they may not have any idea.

They hoped that employers pay attention to the fact that they did a minor in IT and ask about the minor. However, this may not be a very realistic expectation, considering that most employers receive a pile of job applications everyday and do not spend much time reviewing each application. Dave stated that he would explain about his minor during his job interviews.

> That's what I am hoping. I am assuming that they will know... I am hoping that they are gonna ask... like, "What is this?" When I am in an interview, or in a follow-up interview, "Hey, we know you did a minor, tell us about you minor." That's what I can answer "here's where I learned database." I am wanting to go talk to, next semester, the IT advisor about how I can be prepared for answering

questions about that what are the good answers, like database, that's something I will personally need to do. I need to do some research how I can answer that question.

Similarly, Chris wanted future interviewers to pay attention to his unusual combination of education, Philosophy and IT.

Interviewer: Then would your future employer know what your degrees are? Like philosophy and ITS minor, would they know what you wanted?

Chris: Ideally, I tell them. Hahaha… They would, I did get some funny looks when I applied for my internship, but it was a face-to-face interview, so I was able to explain to them, as I explained to you, the various reasoning for my educational progress, which I think is another indication of, I think I'll definitely have to fight a little bit, about the frequency of notion of Computer Science, and Computer Science degrees, when applying to a company that says only Computer Science degrees, I say, "Well, no. I actually have Philosophy of Computer Sciences." And the first reaction is going to be "Oh, oh…" As long as I have an opportunity to explain what I believe are legitimate reasons for my educational path, then I think that should work out fine. And to be perfectly honestly, if they are not interested in listening to what I have to say, then I don't want to work there. So far as I have no problems with that whatsoever, I anticipate having to deal with it at some point, but it really hasn't caused me much difficulty.

Interviewer: I was just wondering, because the stereotypes that people have about majors are quite strong.

Chris: I definitely agree. But I haven't encountered any problems yet. Just given by people's general reaction, when I say that I want to work with computers, they ask, "What's your major?" "Philosophy," this reaction isn't "Oh, okay." Instead "Wait, explain it to me," So just based on those kind of reactions, I do anticipate I will have to deal with much more so than if I were to just say "It's Computer Science," and be done.

Students' other concern about employers' possible misleading expectations about the IT minor was that it might point to programming skills that Computer Science majors would have. Lisa, an English major, was worried that employers might misunderstand having the IT minor as having technical computer skills.

> What if a person who sees the IT minor expects that you have some technical expertise, you know some programming... so what if they expect me to have that kind of things? That's what I'm concerned... I don't want them to think that I can make a program for their company, or something like that when I can't.

Rachel's comment indicated that as long as employers take people with an IT degree as ones who would do computer fixing work, it would be hard to persuade students to consider the IT minor.

> Um... I don't think so... from a recruiter's point of view... It would be very helpful because I asked some of them, what would they think of IT minor help someone get a job. I think a lot of recruiters would misunderstand, they think of IT as Computer Science, so they think oh, you're an accounting major, we need you to do accounting, we don't need you to fix computers. That's their idea. I don't think they would understand that... They will not understand what this is.

The significance of employers' awareness about the IT program is consistent with Nuhfer (1999)'s argument that raising employers' awareness is significant in the sustainability of an interdisciplinary program because employers tend to hire students whose majors they can easily understand.

9.4.3 Peers

In Chapter 4, it was pointed out that students' IT competency perception was very much a generational phenomenon. Students gauged their IT competency in comparison with that of their peer groups. They did not compare their IT competency with either old generation people or younger generation people. The interview data strongly supported the insight that raising peer awareness about the IT minor would be important. Peers' understanding was often mentioned in the context of the fact that the IT minor was being offered as a part of the Library and Information Science programs at the time of the

interview. The stereotype of librarians' job did not positively appeal to their peers who were not enrolled in the IT program. The participants did not care about the stereotype, but it implied that how their peers value the IT education would be another success factor for the IT program. Rachel talked about such an episode that she had with her friend.

> I think this minor would be appealing to other students in my major, if they know about it. I don't think a lot of people know about it. A girl in my business fraternity, I was once reading my... some reading I had to do for the class during a different class, and she was sitting next to me and asked what class was that for, I said "Oh this is for my LIS class," and she asked what that was, and I said. "it's Library and Information Science class," and she started laughing because she thought Library and Information Science is about books, how to be a librarian. I said "Oh no, it's in an IT minor... it's about information and technology issues," and she said, "Oh, I didn't know that, that sounds really interesting," and she said "that sounds relevant to Business." But when people hear about it first, they kind of laugh and ask, "Why are you doing that? Why are you reading about being a librarian?" [laugh] Then I said, "Yeah, it's in the Library and Information Science but it is not about being a librarian."

Other participants, Ricky and Andy, commented about the same misconception.

> Ricky: When I mentioned that I am taking this course, most of my friends would ask. "Why are you taking a Library Science course?" ... So they would think "librarians" as opposed to research into technology and how it affects people.
>
> Andy: To some students in Computer Science, or Sociology or Social Sciences, but even that's hard to sell. You can't really go up to people and say, "Hey, would you like to be a librarian?" because I am sure most librarians are old women, who shelve books. That's boring. So I mean, for guys at least, maybe just to promote up some technological things. I know this, at engineering open house, the college had food... That was kind of neat to see. I went out my way to visit it, just to see what it is and how it's going, you know.

From the students' descriptions, it could be concluded that how the field of the IT program is pictured in their peers' mind strongly influences students' intention to actually pursue the IT minor.

Participants thought that everybody in college should know that the IT program could be related to any fields. Lucy said:

> So I think maybe the thing that would make it more appealing is just... Like "Information Technology Studies," I think a lot of people will like "What is that even mean?" I think, more advertising, in a way that it sounds useful to people, because if you just say "take the Information Technology Studies minor" people might be like, "Why? What is that?" you know, what is that gonna do for me or what does that even mean, I think what would be helpful is you're getting technical skills that you can relate to a lot of LAS, humanities type of major, show more connections between what the minor does, and what it could do for people.

Their comments indicated that marketing of the IT program should be directed not only to the students, but also should be directed to all the stakeholders who are important to students. Advertising to student peers would be particularly helpful. It suggests that an effort should be made to raise overall awareness of all the stakeholders about this unique learning opportunity.

This section has shown that students do not choose the IT minor purely by their own interests in the subject matters in the IT program. How other stakeholders who were important to them conceive the IT minor was an important consideration for them to choose this minor. Participants' comments about the importance of other stakeholders' awareness of the IT program correspond with the recommendations that Nuhfer (1999) made that multi-level supports are crucial to sustain an interdisciplinary program which often does not have an automatic identity associated with their names.

9.5. Summary

Many participants found the IT program supplemented their major well. They wanted to explore issues closely related to IT, which they did not usually get enough from their

majors. Students' decision to choose a minor usually came after they had chosen their major field. Participants decided to choose the IT minor with different considerations from the reasons of choosing their major. While they chose their majors based on their judgment about what they liked and what they were good at, they chose the IT minor if they liked IT or not, or if they were good at dealing with IT or not. The decision to take the IT minor was frequently made with practical considerations, after starting to examine different career options that they could choose with their major. Many participants chose the IT minor as a way to make up for their major or to narrow down to a specific IT related area in the field that they hope to go into. They found that the IT skills and knowledge as valuable add-on skills to their expertise they had obtained from their major field. As such, when they considered choosing the IT minor, they weighed the relative value of the minor with that of other value-adding opportunities, like internship, study abroad, a campus honors program, and extra-curricular activities.

Students felt that knowledge about IT is a necessity for anybody who lives in the contemporary time, but at the same time they felt that their IT education would give them a significant edge over other people who did not get such education. The decision to pursue the IT minor was not made just by the participants' own interests. Understanding of their peers and other authority figures about the IT program was very important for them in making their decision to pursue the IT minor.

10. CONCLUSIONS

This chapter summarizes the major research findings of this study and discusses their implications. In the sections that follow, I first briefly summarize the major themes that emerged from the analysis of the interviews. Students' generally high self-perceptions of IT competency, changing understanding of IT, diverse interests in and motivations for IT education, strengths and challenges of an interdisciplinary program, and students' career concerns regarding IT education have emerged as important themes in the analysis of the interview data. I also discuss the practical implications of these research findings for administering an IT program. I conclude with an account of the limitations of this research project and a suggestion of some directions for future research.

10.1. Emergent Themes

10.1.1 Generally High Self-Perceptions of IT Competency

Most participants in this study felt that their IT competency was relatively high. This suggests an affirmative answer to the first sub-question: Do college students perceive themselves as being technically competent? The interview data revealed that in general college students perceive that they are good at dealing with IT in their everyday life. Participants grew up during the internet boom of the 1990s. Most participants reported that they had home computers when they were kids. A few participants who did not have home computers when they were young nevertheless had opportunities to use computers while attending school. Early and ongoing experience with computers is the basis for the feeling of most participants that they have at least some basic familiarity with IT. These students took some level of IT competency for granted, without explicitly questioning it. This finding is consistent with Bruce (2003)'s observation that students living in the information age are adeptly accommodating new technologies into their existing practices to accomplish their purposes.

While their overall competency perception was relatively high, this was not a stable feeling. One situation in which students judged their overall IT competency differently

was when their technical skill levels, especially programming skills and hardware knowledge, were the issue. When most non IT-related majors confronted technical problems, such as creating web pages or fixing hardware problems, they felt that they were not good at dealing with computers. These perceptions were different depending on how they framed their role in dealing with a computer; for example, as a user or as a developer of computer applications. When students considered themselves as users of consumer computer applications or online services, they felt that their IT competency was relatively high. On the other hand, when students felt a need to create something on a computer independently, even something as simple as a basic webpage, they tended to feel that their competency in dealing with IT was not sufficient. Researchers who are interested in technological developments have observed an evolution of computer technologies that has continuously lowered the barriers to creating or tailoring applications. As such, the HCI communities anticipate a fundamental challenge of developing computing environments that assist end users who do not have much technical expertise (e.g., Lieberman, Paterno, Klann, and Wulf, 2006). Nevertheless, when most non IT-related majors confront technical activities that developers used to conduct in the past, they feel that they do not have a high enough competency to carry out the tasks. By contrast, most technological majors tend to take their competency in dealing with IT for granted because they have acquired a rich understanding of many IT-related issues as a result of their intensive academic training in technological topics.

As participants took some level of IT competency for granted, they were not intentionally examining their own IT competency in everyday life. They rarely examine if they are competent enough in dealing with IT, unless something that questions their IT competency occurs. In other words, they examine their IT competency when some situational needs prompt them to do so. One such prompting factor is comparison of their IT competency with their peers. Students often compare their IT competency with that of their peers, but not with younger people or older people. This finding indicates one significant value of building an IT program may be providing students with an opportunity where diverse students from across campus come together and interact with each other with various IT-related topics.

An additional factor that determines students' perceptions of their IT competency is the setting of IT use. When the IT related problems were situated in the context of their everyday lives, students believed that they could handle the problems without much difficulty. In contrast, when students dealt with their IT related problems in a class context, they were not as confident about their understanding of IT skills and knowledge. The challenges they faced in a class context included interaction with their peers, exposure to diverse IT related issues, and dealing with technical topics if not as technical as the training of the traditional computing programs. Also, impending graduation is another factor that prompted the re-evaluation. Participants viewed their IT competency was good enough for college students, but did not feel as confident when graduation was approaching. When confronting the transition from education to the real world, they re-considered their computer skills and knowledge in the context of the career fields that they were pursuing.

All these findings indicate that students feel a need to acquire IT skills and knowledge when those skills and knowledge become immediate and meaningful to the students themselves in some way. It can be easily assumed that students would look for an opportunity for IT education if they feel that they are not competent enough, but my research findings indicate that the relationship between their competency perceptions and their intention to seek an IT education opportunity is not that simple. Overall, findings in Chapter 7 indicated that students' perceptions of their own competency made them more interested in pursuing IT education, either wanting to engage in creating digital artifacts by themselves or wanting to discuss various social implications of information technologies. It seems that their self-perceived competency serves as a foundation for acquiring additional technical abilities.

10.1.2 No Longer Just a Gaming or Typing Tool

Chapter 5 described the way in which the meanings that students attach to computers change when transitioning to college years. Most participants indicated that as children they considered computers mostly as an entertaining device or a study aid. However, as they progressed through their college years, students came to feel that computers were tools that would significantly contribute to their productivity and creativity. Computers

also have become a significant communication tool, not only for socializing but also for study and work purposes. This changing understanding of information technologies motivates students to get a more comprehensive understanding of computers. Furthermore, it motivates students to acquire more knowledge of information technologies through formal education in college, in spite of the now well-agreed user phenomenon that users typically learn computer usage informally from each other rather than from formal means.

Chapter 6 described the perceived limitations of existing educational opportunities. Many participants thought that Computer Science was not an appropriate learning opportunity for them, mostly because the CS program requires students to build a strong basis of fundamental math principles. Previous literature has identified these math requirements of the CS curriculums as a significant barrier for students to get into the CS field (e.g., Devlin, 2003; Freeman and Aspray, 1999; Kramer, 2007). Those math requirements as fundamental computing training are the same barrier for students who are interested in computing education but are not aiming to become computing professionals. Therefore, the CS program is not taken as a good fit for their needs for computing education. This gap in college education regarding computing makes students turn their attention to other learning opportunities.

These findings from Chapter 5 and 6 about students' needs for formal IT education provide a positive answer to the second research sub-question, "do students need formal education in IT?" In spite of students' familiarity with computers for informal purposes, students increasingly feel that some formal knowledge of IT is important for them as they prepared for a transition from school to work. Therefore, students seek a formal learning opportunity to build on their comprehensive understanding of computers. These findings developed into the later discussions on the relationship between IT education and students' career considerations in Chapter 9.

The soundness of these findings is confirmed by some related studies which have examined young people's motivation to acquire computer skills. Although there is no comprehensive framework that explains the ways in which diverse types of people learn computers, several studies point out that the meaning that people attach to computers

plays a critical role. For example, Facer et al. (2001) argue that peer appreciation obtained from their adeptness of dealing with computers significantly influences children's motivation to achieve high computer competency. Likewise, for college students, the meaning that they attach to computers would explain their motivation to learn IT. For college students, computers are not just for entertainment or socializing, but are the tools that would significantly enhance their productivity and creativity. Therefore they try to get a comprehensive understanding of computers through formal education in IT. Students sometimes even take receiving formal education in IT as a way to confirm their IT competency in carrying out their important tasks that include IT applications.

There have been a number of studies that investigated how people obtain computer skills. The most persuasive explanation is that learning computer skills often occurs in users' social surroundings (e.g., Twidale, 2005). People participate in the practices of using computers while interacting with other people, sometimes with peers and co-workers, or sometimes with family members. Simply sitting in front of a computer together and showing what happens by clicking an object is much easier than verbally explaining the steps involved in the problem solving process. Therefore, informal learning is frequently observed, because it is easier and more efficient than learning through formal ways of taking classes or reading manuals. How to incorporate the informal learning with formal IT education together has not been fully answered yet. Identifying the ways to effectively put informal learning and the formal education together may be a significant challenge that IT programs have to address.

10.1.3 Students' Interests in and Motivation for IT Education

Students' interests in and motivations for IT education that is different from the traditional computing education programs are varied across a wide range. Chapter 7 described students' interests in IT education that are largely laid out around two poles. One is learning practical computer skills. The technical skills that students were interested in were not like the fundamental computing principles and skills that have been taught in traditional computing disciplines. The other is understanding social implications of IT, the various impacts of IT implementations on different social processes. Many students initially came to the IT program with a preference for either learning technical

skills or learning social implications of IT. However, many of them indicated that they had become appreciative of the other type of topics as a result of taking classes in the IT program.

Many participants indicated that they were especially interested in understanding "how humans interact with computers" in the IT program. This indicates that students commonly want to understand computers within a social context, although some emphasize the technical pole and others emphasize the social pole. Often, students' interests in learning technical skills were focused on creating web pages that could engage users. Students' interests in learning social implications of IT were geared towards understanding immediate user contexts, rather than larger institutional variables that were typically dealt with in the existing social science disciplines. Their interest, broadly described as "how humans interact with computers," is broader than the "human-computer interaction" in the CS sense, and points instead to an intermediate field that blends the technical and the social issues of IT. Students' strong interests in this unique aspect of dealing with "how humans and computers interact" suggest a potential defining characteristic of the field of IT education in college.

Similarly, students' motivations for IT education were also dispersed around two poles; their passion and practical reasons of learning IT. Some participants pursued the IT education entirely out of their inherent interests, and some other students pursued the IT education mainly out of their practical considerations. However, the majority of the participants expressed mixed considerations of inherent interests and practicality, often more strongly inclined to practical interests. This finding strongly suggests that students' practical considerations in taking the IT education opportunity, as well as their inherent interests in IT, should be respected by educators in this field. Participants who did not show a notable level of interest in the IT education programs showed that if the IT education program does not have a distinctive practical value, students would not specifically consider this IT education opportunity regardless of their interest level. This value of practicality continued in exploring the other research questions that were related to students' majors and career considerations. Also, the value that students place on practicality indicates that the IT program is an intermediate field between their school life

and everyday life. This finding continued with the in-depth discussions on students' career considerations in Chapter 9.

10.1.4 Strengths and Challenges of an Interdisciplinary IT Program

In Chapter 8, many participants pointed out that the interdisciplinary nature of bringing previously separate topics together, technology topics and the Humanities/Social Science topics, was the most characteristic and valuable aspect of the IT education program. Not only the benefits of the IT program, but also many problems and challenges participants reported about IT classes were associated with the interdisciplinary nature. While students welcomed the interdisciplinary topics of the IT classes, they expressed mixed feelings about the interdisciplinary class practices. Students reported that they were confused about overlapping class content, skimming of many different topics in a short time span, uneven technical expertise among classmates, unclear class expectations for students, and administrative confusion that is due to the lack of awareness of the administrative staff.

In particular, the problems arising from the lack of other people's awareness about the IT education program reported in Chapter 9 point to an important issue. This is closely related to a typical identity problem inherent in most interdisciplinary programs (e.g., Nuhfer, 1999). Nuhfer (1999) argues that unlike existing disciplinary programs that take advantage of their well-established identities, a newly built interdisciplinary program tends to lack such an identity. Therefore, promoting its identity to various stakeholders is critical to achieve sustainability. Participants' frustration about their peers, educators, and future employers' lack of awareness about the IT program in this study strongly confirms the point. External stakeholders' awareness significantly influences students' actual motivation to take the interdisciplinary IT education opportunity.

Among the many challenges, balancing the technical and the non-technical components within an IT class was pointed out as a major problem. Technical activities included in many IT classes caused a very contradictory feeling. Most participants welcomed the fact that they could learn practical technical skills from the IT program, but each student perceived the optimal balance between the technical components and social components within the curriculum differently; some students thought the classes taught technical

skills too much, while others felt the opposite. Some students thought that the expected level of technical expertise was too high, while others thought it was too low. In sum, the problems that the participants reported above point to a different set of challenges that the interdisciplinary IT program should deal with, along with the limitations identified in the previous studies.

Participants also reported that the IT classes adopted advanced class practices, such as allowing flexibility in administering classes, assigning group projects, and promoting open discussions. These advanced practices may have been an unavoidable choice to approach technological topics that rapidly change. These characteristics contributed to students' feeling that the IT program was an atypical type of education in college, which addresses the issues that are not limited to their college life and academic training.

10.1.5 Students' Career Considerations

Students determine the value of IT education in the middle of pursuing their career paths that would build on their college education. The last two research sub-questions respectively ask how students' perceptions of the IT program are related to their majors and their career plans. My research findings indicated that students' majors and career plans should be considered together in determining their interests in IT education, rather than as two separate factors. Students usually consider the IT education opportunity after deciding their major. In general, participants wanted to supplement their majors with the IT minor. Students from the Humanities and Social Science fields tried to supplement their majors by adding technical skills and technical discussions; whereas IT-related majors wanted to obtain more practical hands-on skills or to add knowledge of social implications. Overall, students sought the IT minor for some practical purposes related to their future career plans, rather than to academically make up for their education in their major fields.

Different types of majors had different issues about the IT education program. Some majors do not have much to do with technological innovations. This group included majors such as English, History, and Sociology in this study. Some other majors are not technical in themselves, but are being more heavily influenced by technological innovations than the first group. This group included Media Studies, Journalism and

Advertising. Another group was business majors that included Accounting and Finance. These majors prepare students for relatively well-defined job sectors and emphasize obtaining a fairly well-defined set of professional skills and knowledge. Motivations of the students in these majors for IT education were not very high, as taking the IT minor did not add much practical value to the skill requirements of those fields. The last group was technological majors. As more computing power is made available to end users, users develop more sophisticated knowledge of how computers could be used to increase their productivity (Goldberg, 2002). Therefore, studies point out that this change requires computing professionals to continuously hone their abilities to interact with those empowered end users. Communication and organization skills, and business skills are increasingly emphasized in addition to their technical expertise (e.g., Freeman and Aspray, 1999). The different concerns expressed by the participants from different majors suggest that an IT program should understand students' different career-related considerations.

Overall, the strong expectations for versatility and well-roundedness coming from the current job market worked as a significant motivator that influenced students' intention to seek the IT education opportunity. Students felt that the desired qualifications of the real world of work were becoming very intensive. Therefore, participants tried to make themselves as unique as possible to stand out from the large pool of candidates with otherwise similar qualifications. Students also expressed a desire to be able to work with their own scrutiny, rather than to conduct routine tasks under other people's supervision. They viewed strong knowledge and skills of IT as a basis upon which they can build such abilities to work independently.

Beyond employability, students consider IT education important to their careers. Participants' narratives in this study did not clearly address the long term career considerations; however, responses in the interviews certainly reflected the changing requirements for developing their future careers. The term "career" means a sequence of a person's work experiences over time (Arthur, Hall, and Lawrence, 1989), unlike "job," a term that indicates discrete one time employment opportunities. From the research findings, it could be concluded that even if the primary objective of the IT program is not

enhancing students' job prospects, its major objective should include helping students develop their career plans.

Career researchers commonly claim that the old practice of stable employment has faded; instead, careers increasingly include dynamic employments and boundary-less careers that are not constrained to a single employer or a linear path of career advancement (e.g., Arthur and Rousseau, 1996). Gray (2001) finds that one significant source of these changes is the rise of ubiquitous computing. According to him, ubiquitous computing continuously transforms the relatively static stock of knowledge that had been needed for traditional careers. It has changed the way in which knowledge is used and has made many of the practices inherited from the past less workable. Hence, ubiquitous computing has changed stable careers into more dynamic ones.

The new career concepts are significant because of their ramifications for higher education. The "boundary-less" career suggests that people must take responsibility for their own future careers. They will not stay with a single employer, and will not necessarily advance in a hierarchy. They will plan their own projects and will make up their own ways of carrying out those projects. Those projects may not be carried out in a single organization, but in personal networks and professional communities. Therefore, college students transitioning to their working life should prepare for this shift by inculcating entrepreneurial attitudes and skills for a form of working life in which they start and develop enterprises or find new projects by themselves.

Most participants were not able to articulate the nature of the changes that they should expect, but they nonetheless felt that they should prepare for these changing requirements. Although participants frequently talked about the possible benefits of marketability gaining in terms of jobs while talking about the IT education opportunity, it was just one manifestation of their hope to be better prepared for their life beyond college. The research findings suggest that the IT program certainly should help students think about their future life in a world where technical innovations are ubiquitous, even if its primary focus is not improving students' job prospects.

10.2. Practical Implications: A Way to Go

The results of this study hold various implications for practice and could be used by educators and program developers who are envisioning to establish or improve an IT education program.

First of all, the findings show that students' interests regarding some sort of computing education are now common. Many students have at least some level of interest in the topics related to IT development, widely ranging from technical skills to social ramifications. This is largely due to the fact that IT is so closely embedded in various facets of people's everyday lives. The findings of the study present the worthiness of conceiving this new field from students' perspectives; a field that would fill a niche of existing disciplinary areas, traditional computing disciplines, and the other disciplines that provide important insights to understand the contexts of information technologies. The necessity of conceiving an intermediate field between technical and social, between academic problems and everyday problems, and between formal education and the real world, was reinforced by the findings of this study.

Second, the study's findings highlight students' perspectives about IT education which are very different from those of educators. Most educators involved in developing or teaching in IT have received advanced education in a related field, most frequently at a doctoral level. Many of them are already working as professionals in computing and information fields. A major reason that these educators have pursued their advanced degree and chosen to continue working in the IT field is that they have some passion for technology-related topics. However, the motivations of students at an undergraduate level are different from those of educators. Students often feel that they need to have this type of computing education regardless of their level of inherent interest in technologies. This discrepancy implies that students' practical considerations may have received less attention from educators than they deserve. Educators may need to focus more on students' practical considerations in administering the program.

The third practical implication has to do with administering an interdisciplinary program. Students, like educators who first conceived the need for this type of computing education, perceive the field of IT as an interdisciplinary field where many different

components that have not been previously connected are brought together. Students' comments about the problems that they had experienced in the IT program strongly signaled that the challenges of building and administering an interdisciplinary IT program may be more serious than generally understood. Some of the special challenges in running an interdisciplinary program are well documented in several studies (e.g., Nuhfer, 1999). Students' comments about their experiences in the IT program documented in Chapter 8 vividly tell that most of those challenges are also present in this IT program. Most of all, as Nuhfer (1999) claimed, continuous support from the multi-level stakeholders is essential for the survival of an interdisciplinary program. These interest groups include students, faculty, administrators, and peer groups that share common interests. Throughout this study, it was clear that peer recognition and awareness of other important stakeholders in the IT program significantly influenced students' interest in joining the program. This observation suggests that it is important to increase people's awareness of the program through various marketing efforts.

Fourth, the findings also suggest program administrators re-examine the current status of the IT program as a college minor. As it is offered as a college minor, students determine the value of IT education by how much value it adds to their own expertise, as one participant compared the value of his IT education to "adding icing on the cake." The findings show that students often compare the value of the IT education opportunity to other value-adding opportunities, such as internships and study abroad opportunities. It indicates that the unique value that the IT minor program could bring to students should be more clearly communicated to promote this learning opportunity.

Fifth, the different needs of students identified in this study provide helpful information for student advising. Different advising strategies can be planned based on the needs of students from different majors. The following are some ideas.

> Humanities/Social Science majors: IT education can be a means to demonstrate their well-roundedness or to narrow their specialty field down to a more technology-intensive sub-field.
>
> Media Studies, Advertising, and Journalism majors: Information technology innovations have heavily influenced most practices in these areas. For example, the

ways news and advertisements are created and delivered are being significantly changed by technological innovations. Students in these areas want to understand the nature of the changes and increase their adaptability to the consequences accordingly.

Business majors: These students are targeting jobs that are greatly enhanced by IT development. However, these fields typically require students to acquire relatively well-defined sets of professional skills and knowledge. Therefore, the practical value of the IT education opportunity may not be very high for them, as acquiring those professional skill sets takes priority.

IT-related majors: An effective IT worker needs a variety of skills, in addition to their technical knowledge and skills. These additional skills include business knowledge, organizational skills, and communications skills. These additional skills have not been sufficiently addressed within the traditional computing disciplines, and are burdening students in these fields when transitioning from education to the real world of work.

Finally, the findings show that the pedagogical approaches being adopted by many IT classes are appropriate. The characteristic aspects of IT classes include students' active participation in class discussions, introduction to diverse technological topics, intimate interaction with instructors and peers, and emphasis on group work. In particular, peers played a critical role in motivating students to learn more about technologies. Findings in Chapter 4 revealed that students' IT competency perceptions are established within peer groups. The characteristic practices of the IT classes reported in Chapter 8 included promoting students' learning through intensive interactions among themselves which are not typical in other college classes, such as having students work on group projects. Rapidly changing topics like information technologies may need different pedagogical approaches, compared with other typical college classes that deal with a stock of knowledge that changes less frequently than information technologies.

Introducing diverse technological topics to students plays an important role in an IT education program. Many participants came to the IT program initially because of their interests in acquiring practical technical skills and then came to respect the significance

of social implications of IT as a result of being exposed to diverse IT-related topics. This study did not intend to advocate any type of learning theory. However, it confirmed the viability of applying the social learning theories in IT education, which recognizes the fundamental role of social interactions among learners. Initially, students came to the IT education program with a few narrowly focused objectives. Some students wanted to learn technical skills that would allow them to design web pages. Other students wanted to learn how technologies were being utilized in workplaces. However, many students reported that the program allowed them to understand implications of other topics that may have been on the other side of their interests.

10.3. Limitations of the Study

First, the themes that emerged as a result of my analysis do not exactly match up with the initial research sub-questions. Yet, this is typical in a qualitative study that employs the grounded theory approach, which is a bottom-up approach to develop a middle-range theory based on the themes as they emerge directly out of the data collected. The initial research questions are still valid in that those questions directed my exploration of students' diverse perceptions and experiences. Although the themes do not directly respond to the research sub-questions, they do provide some answers to those questions.

Second, the idiosyncrasy of the particular IT program of this study may limit direct applications of the research findings presented here to other similar programs. This limitation results more from the ambiguity of the field itself, rather than the ambiguity involved in this study. The topics that are addressed in the IT program constantly change as technological innovations are continuously being made. Mitchell (2003) points out that the existing IT programs are all different depending on the socio-economic conditions of the local area where each IT program is hosted. Freeman and Aspray (1999) point out that the term IT itself is not clearly defined, and there is a considerable amount of ambiguity involved in defining IT, as is shown from their observation that as many as twenty academic specialties study various aspects of IT regarding its use and applications. They go on to argue that with the spread of the Internet, the rapid merging of traditional communications and computer-based systems has added to the confusion. Therefore, in

addition to being nascent, the field that deals with IT has inherent complexity. Consequently, no one IT program is identical to another IT program. Therefore, while the findings from this study are valuable, applying the findings to other similar programs warrants caution. In this study, I tried to carefully document the characteristic aspects of the research setting of this study to help interpret the research findings. One of those characteristics is the fact that it is being administered in a large government funded state university in the Midwestern area. Another is its status as a campus-wide undergraduate minor rather than as a standalone major. Also, it is built and being administered on an interdisciplinary collaboration of multiple units on campus, rather than under a single departmental authority. These peculiarities are closely related to many findings of this study. While this study brought up many significant issues to consider, readers should sufficiently take their own unique situational variables into consideration in applying the findings to other IT programs.

10.4. Future Research Directions

A study with a larger number of participants is one possibility. This study revealed that students from different backgrounds have a wide range of interests and motivations. This study has value in itself in that it has explored the diversity. However, simply reporting the diverse factors does not inform us of how different factors work together to affect students' perspectives of formal IT education. By having a larger number of participants, general patterns of students' interests regarding IT education would become clearer. Segmentation of students following the identifiable big chunks of interests would be another way to look deeply into their interests in IT education. Examples would include, "Technological majors' interests in IT education," or "Humanities majors' interests in IT education."

Utilizing diverse advertising opportunities of the IT program is a possible way to obtain participants who may have potential interest in IT education, but simply may not be aware of the existence of the IT education program. The email recruiting attempted in this study turned out not to be very effective to obtain such participants. Utilizing advertising opportunities may be a better strategy to reach this type of student for future

studies. One participant in this study suggested the IT program have an open house event as a way to advertise the program, just as other college programs often do. His suggestion was that introducing what this program is about, and showing sample works of students from the classes would greatly attract students to the IT minor. If interviewees are recruited from those events, they could serve as good informants about students' potential interests before actually enrolling in the IT program.

Perspectives of students in early college years may be another potential research area. The majority of the participants in this study were juniors and seniors and the findings reflected those students' perspectives more intensively. The perspectives of freshmen and sophomore students may be different, as the needs of those students for their education are usually in the process of being formulated. Therefore, a study with those students in early college years may provide a different insight about college-level IT education programs.

A follow-up study of graduates with an IT minor is another avenue worth pursuing. Many participants determined the value of IT education in terms of its future utility for their life beyond college education, rather than its current utility for their academic training. It leads us to the following questions. What are those students doing now after graduation? What are the consequences of having this "unusual" IT education opportunity? Did they acquire what they had desired from their IT education?

A survey of a large number of students would be a more practical means to find ways to improve an IT program. The findings from this study provide a groundwork that would make planning this survey research possible. Experts in research methodologies point out that while a qualitative study focuses on processes of an interesting phenomenon, a quantitative study focuses on outcomes of a specific program or a treatment (e.g., Nasser, 2001). A survey method also is a more efficient way of providing answers to specific questions in a timely manner. Besides, an important function of a quantitative study is enabling researchers to make predictions based on objective measures, which may not often be the priority of a qualitative study that aims to understand informants' subjective meanings. Audience is an important consideration in deciding a research method. Therefore, presenting quantifiable measures of the major issues is a persuasive way of

communicating with various other stakeholders, especially with the decision makers who may want to see outcomes that are easy to compare and make important predictions.

10.5. Concluding Remarks

The development of education programs for IT in college is a new attempt to bring a wide range of issues caused by the most notable innovation of our time - information technologies - into college education. As the emergence of the IT programs is a recent phenomenon, prior studies on these programs have typically focused on program developers' and educators' concerns without much consideration of students' perspectives. Often, students' interests have been assumed based on CS educators' typical concerns of nurturing competent computing professionals. In other cases, the programs focus on the larger societal variables which may be distant from students' immediate concerns. In contrast, this study confirmed the worthiness of consulting college students' own perspectives in the process of building a meaningful curriculum for IT, studying college students in an IT education program within a large university in the Midwest as a case.

The findings suggest that students' interests regarding IT education should be understood with careful examination and consideration of their situations as college students. A need to establish a new education program for IT has been conceived with educators' recognition that the rapid development of information technologies has caused a significant niche in college education. Like those educators, students consider IT education as an intermediate area that bridges technologies and social issues, two areas which have not often been discussed in connection with each other. They also consider college-level IT education to be an intermediate area that incorporates their other important values: between their school and everyday lives, and between their formal education and their anticipation for the "real world." These perceptions may have received less attention from educators and program developers, but are crucial in developing an IT program that addresses students' considerations appropriately. How can educators incorporate students' unique interests into developing a sound education

program for IT? This study provides the groundwork for further discussion of that question.

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APPENDIX A. INTERVIEW GUIDE

Interview Guide

Date and time: _____

Participant ID: _____

Major and school year: _____

"This interview is being conducted to learn about your thoughts on college-level information technology (IT) education. I am especially interested in hearing about your personal experience of learning and using information technologies, problems that you have faced, and suggestions for IT education that you may have."

"If it is okay with you, may I tape record our conversation? The purpose of this is so that I can carry on an attentive conversation with you, at the same time not miss any important details. I assure you that all your comments will remain confidential. I will compile all the participants' information for my study without any reference to individuals. If you agree to this interview, please sign this consent form."

"Let me start with some questions about the IT course that you are taking now."

1. What IT course(s) are you taking this semester? Could you tell me the reason you chose to take the IT class? What do you think are good things and bad things about the class?

2. Do you feel that you are generally good at dealing with IT in school, in your social relationships, or to achieve other goals in life?

3. Have you ever had a feeling like "Oh I need to learn more about computers" either at home, at work, at school, or at any other settings? Could you describe the situation?

4. (1) What kind of information technology have you recently learned? What was your experience of learning it?
   (2) From whom do you normally get help to learn about information technologies?

5. Have you ever attended any computer training class, for example, CITES computer training sessions, or any other workshops off campus?
   (1) (If so) What was the training like? Was that training helpful?
   (2) (If not) Could you tell me why you have not tried?

6. (1) (for non-computing majors) Have you ever taken any CS or other computer-related courses before? What was your experience in the course(s)?
   (2) (for computing majors) Have you ever taken any courses that deal with information technologies, not in your current major? What was your experience in the course(s)?
   (3) How does the IT course compare with the course(s) that you just mentioned?

7. Do you have any work experience, either at present or in the past, other than your school work?
   (1) What are the information technologies there like? How are information technologies being used there? What are your tasks? How do you use IT for the tasks?
   (2) Who are the people whose tasks are closely related to yours?
   (3) Could you tell me any difficulties you had while working there?

8. How did you choose your current major? Any critical factor/experience that influenced your decision? What are the good things and bad things about your major?

9. What kind of job do you think you will pursue after graduation? Is there any special reason that you want to pursue it?
   (1) What qualifications are required for the job? What abilities are especially valuable?
   (2) How would your current major help get the job that you want? What else are you doing (considering) to be qualified?
   (3) What are the biggest challenges that you expect in building a career in that area?

10. Did you know that there is an IT minor program on campus?
   (1) If aware, and in the minor: How did you find out about it? Was there anybody who recommended it? Could you tell me the reason that you joined it? What value does the minor have for you?

(2) If aware, but not in the minor: How did you find out about it? Is there anybody who recommended it? Are you interested in joining the minor? Any circumstances that make joining it hard for you?

(3) If not aware: Would you be interested in joining such a minor?
- (If yes) What value would the minor have for you?
- (If no) What are the reasons that you would not be interested?

11. What would you expect to be included in an IT education program?

12. Do you have anything that you want to add about the issues that we have discussed? Any questions or comments?

APPENDIX B. INTERVIEWEE PROFILES

Table 1. Participants of the Study

	Name	Major	School Year	IT minor	Number of IT courses taken	CS class experience	Career field pursuing
1	Aaron	History	Senior	Yes	6	Yes	Libraries
2	Abby	Journalism	Junior	Yes	6	Considered	Journalism
3	Andy	Political Science	Junior	Yes	6	Yes	Government
4	Brad	Economics	Senior	No	1	Yes	Commercial Banking
5	Chris	Philosophy	Junior	Yes	4	Yes	Graduate School in Human-Computer Interaction
6	Claire	English	Senior	Yes	6	No	Graduate School in English
7	Dave	Political Science	Senior	Yes	6	Dropped	Government
8	Emily	Psychology	Senior	Yes	6	Dropped	Libraries
9	Eric	MIS	Junior	Yes	5	Yes	Self business
10	Jack	Advertising	Junior	Yes	6	Considered	Advertising
11	Jake	Advertising	Senior	No	1	No	Advertising
12	James	Aviation	Senior	No	6	No	Aviation
13	Janet	English	Senior	Yes	6	No	Publishing
14	Jenna	English	Junior	Yes	3	Considered	Publishing
15	Kate	English	Senior	Yes	6	Yes	Libraries
16	Kelly	Media Studies	Senior	Yes	6	Considered	Libraries
17	Larry	English	Senior	Yes	5	Yes	Law
18	Lauren	Sociology	Senior	No	1	No	Social work
19	Lisa	English	Senior	Yes	6	Yes	Undecided
20	Lucy	History	Junior	Yes	3	Yes	Undecided

Table 1 (cont.)

	Name	Major	School Year	IT minor	Number of IT courses taken	CS class experience	Career field pursuing
21	Matt	Computer Engineering	Junior	No	2	No	Computer Engineering
22	Nathan	Computer Engineering	Senior	No	1	No	Computer Engineering
23	Rachel	Accounting	Sophomore	No	1	Yes	Accountancy
24	Ricky	Chemical Engineering	Sophomore	No	1	Yes	Chemical Engineering
25	Sarah	Computer Science	Junior	No	0	Yes	Programming
26	Taylor	Finance	Sophomore	No	1	Yes	Law
27	Tom	Psychology	Senior	No	0	No	Social work
28	Zachary	Computer Science	Senior	No	2	Yes	Programming

Table 2. Gender of the Interview Participants

	Number of participants	Percentage
Male	16	57.1%
Female	12	42.9%

Table 3. School Year

	Number of participants	Percentage
Sophomore	3	10.7%
Junior	9	32.1%
Senior	16	57.1%

Table 4. Participants' Majors

Major	Number of participants
Accounting	1
Advertising	2
Aviation	1
Chemical Engineering	1
Computer Engineering	2
Computer Science	2
Economics	1
English	6
Finance	1
History	2
Journalism	1
Management Information Systems	1
Media Studies	1
Philosophy	1
Political Science	2
Psychology	2
Sociology	1

Table 5. IT Minor Enrollment

	Number of participants	Percentage
IT minor	16	57.1%
Non-IT minor	12	42.9%

Table 6. Number of IT Minor Classes Taken

Number of IT classes taken	Number of participants	Percentage
0	2	7.1%
1	7	25.0%
2	2	7.1%
3	2	7.1%
4	1	3.6%
5	2	7.1%
6	12	42.9%

VITA

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M.S., Library and Information Science Aug. 2003
University of Illinois at Urbana-Champaign

M.A. Psychology Aug. 1995
Seoul National University, Seoul, Korea
Concentration in Industrial/Organizational Psychology

B.A. Psychology Feb. 1993
Seoul National University, Seoul, Korea

PROFESSIONAL EXPERIENCE

Assistant to Information Specialist 2007-2009
The Career Center, University of Illinois at Urbana-Champaign

- Assisted 400+ students with career exploration and employment search strategies
- Maintained the Career Resource Center website (www.careercenter.uiuc.edu)
- Conducted web analytics of the employer service website (www.hireillini.com)
- Developed and led career workshops
- Provided online career assistance on the Virtual Advising Board
- Provided one-on-one resume/cover letter critiques

Program Analyst 2005
Information Technology Studies Minor, University of Illinois at Urbana-Champaign

- Conducted a trend analysis of student enrollment in the Information Technology Studies Minor at the University of Illinois 1999-2005

Peer Computing Consultant 2001-2002
University Housing, University of Illinois at Urbana-Champaign

- Assisted computer users dealing with various computer problems
- Maintained University Housing computer labs

Assistant Human Resources Manager 1996-1998
Samsung Electronics, Seoul, Korea
- Coordinated a company-wide Information Technology (IT) Proficiency Test
- Designed a Human Resources Knowledge Management System (KMS)
- Supported implementation of an Electronic Document Management System Coordinated domestic/international recruiting
- Served as a member of Samsung Aptitude Test (SSAT) Development Committee

Independent HR Consultant 1995-1996
- Developed Samsung Electronics Aptitude Test for international recruiting

RESEARCH EXPERIENCE

Research Assistant 2002-2003
Information Science Research Lab, University of Illinois at Urbana-Champaign
- Conducted usability testing of Biological Information Browsing Environment (BIBE; www.biobrowser.org)
- Designed and administered BIBE training sessions

Research Assistant 2001
Department of Educational Psychology, University of Illinois at Urbana-Champaign
- Collected and analyzed faculty employment data for the study of women faculty's promotion through UIUC faculty ranks

Research Assistant 1993-1995
Industrial/Organizational Psychology Lab, Seoul National University
- Collected and analyzed survey data on LG Electronics New Leadership Model Development Project
- Conducted a follow-up study of LG Oil Refinery M&A case
- Analyzed cases for Samsung Electronics Organizational Culture Diagnosis Project

TEACHING EXPERIENCE

Teaching Assistant 2003-2007
Informatics Minor (former Information Technology Studies), University of Illinois at Urbana-Champaign
- Courses:
  - Information, Organization, and Technology
  - Social Aspects of Information Systems
  - Information Storage and Retrieval
- Led discussion sections
- Individually advised students for various academic concerns

- Prepared course materials/Graded papers and exams

Instructor 1995
Korea Aviation University, Korea
- Introduction to Psychology

PRESENTATIONS AND PUBLICATIONS

- Just me in a closet with a computer: student perceptions of an undergraduate IT education program. Paper presented at the i-Conference. Los Angeles, CA. Feb. 2008
- Do we really need Boolean? Guiding information retrieval for novice web searchers. Paper presented at the Thinking through New Media doctoral conference, Duke University, Durham, NC. Jun. 2006
- Literacy vs. competency: ICT learning needs in colleges. Paper presented at Connections 2006, Syracuse, NY. May 2006
- Boundaries of information science. Panel discussion at Connections 2006, Syracuse, NY. May. 2006
- Who needs information literacy? A political economic perspective. Poster presented at ALISE 2006, San Antonio, TX. Jan. 2006
- Work-family conflict: Relationship between individual difference variables, work variables and family variables. Master's thesis, Seoul National University. Aug. 1995

AWARDS AND SCHOLARSHIPS

- Dissertation Completion Fellowship, Graduate School of Library and Information Science, University of Illinois at Urbana-Champaign Summer of 2007 and 2008
- Competitive Conference Travel Grants for Doctoral Students, Graduate School of Library and Information Science, University of Illinois at Urbana-Champaign 2008
- Scholarship for Academic Achievements, Seoul National University 1993-1995

COMPUTER SKILLS

- Microsoft Office applications
- Statistical analysis package – SPSS
- Web authoring applications – Dreamweaver, Frontpage
- Databases – Microsoft Access, MySQL
- Operating Systems – Windows, UNIX, LINUX, Mac-OS