Developing a Human Computer Interaction Course for an Information Technology Major

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***Abstract* – It has been reported that even in the slowing economy in the United States, that the field of technology will continue its projected growth in the job market through the year 2018. Consequently, many institutions have begun to offer degrees that specialize not just in engineering or computer science, but in information technology, as well. Degrees are offered at the associate's, bachelor's, master's, and PhD levels from a variety of two-year and four-year institutions. Students who major in information technology explore management and information theory. More specifically, students focus on current technology trends and applications as it relates to the business and communication applications of computing with special emphasis on e-business, e-commerce and business computing. As a result of the merger between technology and business many of the degree programs especially at the undergraduate and graduate levels offer specific courses in human factors in information systems or human-computer interface to cover designing systems with human behavior in mind. The aim of this paper is to present the development of an undergraduate human computer interaction course for a newly developed information technology major leading to a bachelor's degree in information technology. The paper presents the teaching pedagogy selected for the course; course description including course outcomes and topics; and, student assessments. Also discussed are challenges in the development of the course as it relates to being cross-listed for enrollment by both information technology and computer science majors.**

Keywords – ***Human computer interaction; information technology; undergraduate students.***

I. INTRODUCTION

In the United States, the software development industry is about a $220 billon industry which involves approximately 50,000 companies [1]. Roughly sixty percent of the software development revenue comes from software publishing or generic products, while the rest comes from customized products commissioned by a particular customer [1]. This trend influences the software development industry and the way in which newly trained technologists view the development of products and its users.

Users of these new technologies demand more from their systems now more than ever. Long gone are the days of command-line interfaces where only those "professing to be experts" in technology usage can claim ownership in the technology wars. However, now anyone who carries a cell phone, or uses a PC to type a paper, or "friends a person on Facebook" considers themselves a technology aficionado. Moreover, as e-commerce, e-business, and e-sharing become the "norm", there is a growing need to extend the focus of software development beyond engineering and computer science to a conversation that involves the management of software and the ability to connect customers with the software.

The aim of this paper is to present a re-designed human-computer interaction (HCI) course to be offered in a newly developed information technology (IT) major at a medium-sized four-year university. The IT major is offered in the Department of Computer Science as one of two undergraduate degrees granted within the department. The original course [2], although designed to attract students from varying backgrounds, was typically taken by computer science and engineering majors, with a handful of social science majors. Students with other backgrounds, especially those in business, when asked, stated they were not attracted to the course because of the technical implications of the course and its prerequisites. Consequently, the newly re-designed course removes some of these barriers.

The paper begins by providing a brief introduction to information technology as a discipline. The following section provides a brief history of human-computer interaction and discusses the rationale for its inclusion as a required course in the IT curriculum. The next section presents the teaching pedagogy chosen for the course, the course description, and how students are assessed. Lastly, some challenges in offering the course as an inter-disciplinary course for a varied audience are discussed.

II. THE INFORMATION TECHNOLOGY CURRICULUM

Information technology can be defined as the processing, storing, and dissemination of textual, numerical, vocal, and pictorial information by a microelectronics-based

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combination of computing and telecommunications [3]. The term first appeared in a 1958 article that was published in the Harvard Business Review. The authors of the article, Leavitt and Whisler commented that "the new technology does not yet have a single established name. We shall call it information technology (IT) [4]." However, since that time, information technology has become an emerging discipline of significant importance, with degrees being offered in the discipline at increasing rates.

In 2005, the ACM Special Interest Group on Information Technology Education (SIGITE) presented its final report for baccalaureate programs in Information Technology [5]. SIGITE chose to define the IT discipline as "in its broadest sense encompasses all aspects of computing technology. IT, as an academic discipline, focuses on meeting the needs of users within an organizational and societal context through the selection, creation, application, integration and administration of computing technologies [5]."

The final report presented the IT Body of Knowledge, learning outcomes, the IT core, IT electives, curriculum models, and course descriptions. It was decided by the group that the aim of an IT program would "provide IT graduates with the skills and knowledge to take on appropriate professional positions in Information Technology upon graduation and grow into leadership positions or pursue research or graduate studies in the field [4]." More specifically, it was decided that within five years of graduation a student must be able to [5]:

- Explain and apply appropriate information technologies and employ appropriate methodologies to help an individual or organization achieve its goals and objectives
- Manage the information technology resources of an individual or organization
- Anticipate the changing direction of information technology and evaluate and communicate the likely utility of new technologies to an individual or organization
- Understand and for some to contribute to the scientific, mathematical and theoretical foundations on which information technologies are built
- Live and work as a contributing, well-rounded member of society

It was decided that in order to meet these goals that the IT Body of Knowledge would include the areas of study, identified and presented in Table I [5].

The next section presents a brief history of HCI. Also, stated in this section is the rationale for the inclusion of HCI as a required as part of the IT curriculum.

TABLE I. IT BODY OF KNOWLEDGE

Area of Study
Information Technology Fundamentals
Human Computer Interaction
Information Assurance and Security
Management
Integrative Programming & Technologies
Networking
Programming Fundamentals
Platform Technologies
Systems Administration and Maintenance
System Integration & Architecture
Social and Professional Issues
Web

III. HUMAN COMPUTER INTERACTION: A BRIEF HISTORY

Human-computer interaction has been defined in various ways. Some definitions suggest that it is concerned with how people use computers so that they can meet users' needs, while other researchers define HCI as a field that is concerned with researching and designing computer-based systems for people [6], [7]. Still other researchers define HCI as a discipline that involves the design, implementation and evaluation of interactive computing systems for human use and with the study of major phenomena surrounding them [8]. However, no matter what definition is chosen to define HCI, the concept that all these definitions have in common is the idea of the technological system interacting with users in a seamless manner to meet users' needs.

Human-computer interaction has its roots embedded in the systematic study of human performance [9]. It has been stated that World War II provided the impetus for studying the interaction between machines and humans, as the military for each side attempted to manufacture more effective weapons systems [10]. These research activities led to the development if the field of Ergonomics and in 1948 the Ergonomics Research Society of England brought together researchers of varied backgrounds who had an interest in the design of equipment for human use [8].After the World War, the focus of concern expanded to include worker safety, where more research led to the development of an additional field, human factors [11].

With the advances in technology, the terms, ergonomics and human factors are now often used interchangeably. More specifically, the terms as now defined by the International Ergonomics Associate, the world's leading organization on ergonomics and human factors defines the similar terms as, "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and other methods to design in order to optimize human well-being and overall system performance [12]." These disciplines are noted to have provided the basis for human-computer interaction as both are concerned with user performance of any system, whether machine or

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computer [8]. Consequently, HCI serves as an important area in information technology and the IT Body of Knowledge.

The Department of Computer Science at Tuskegee University developed its IT curriculum based on the SIGITE report and included as part of its core courses, human-computer interaction [5]. The rationale for the inclusion of HCI in the curriculum was two-fold. The first reason to include HCI in the curriculum was to provide students with an opportunity to gain a knowledge base in an interdisciplinary field as information technology is also multi-disciplinary. The other reason was to provide students with an opportunity to gain training in the humanistic side of technology where the focus is not only on the system but on the user as well.

The next section presents an overview of course development. Included in this section is the teaching pedagogy chosen, course description, and student assessment.

IV. TEACHING PEDAGOGY

A. Teaching style

According to Grasha, there are four styles of teaching, which encompass the following [13]:

- Formal authority – instructor-centered approach where the instructor provides and controls the flow of content for the course
- Demonstrator/personal model – instructor-centered approach where the instructor demonstrates the skills that students are expected to learn
- Facilitator – student-centered approach where the instructor acts as a facilitator and the responsibility is placed on the student to achieve results for various tasks
- Delegator – student-centered approach where the instructor delegates and places the control and the responsibility for learning on the students and/or groups of students

The facilitator teaching style was chosen because it is a student-centered approach which shifts the focus of activity from the teacher to the learners. This method includes active learning, collaborative learning and inductive teaching and learning [13]. The facilitator teaching style has been stated to work best for students who are comfortable with independent learning and who can actively participate and collaborate with other students [14]. In particular, this approach was chosen because in education literature, the method has been shown to increase students' motivation to learn, to lead to a greater retention of knowledge, and to positively impact attitudes toward the subject material being taught [15], [16], [17]. Additionally, the method places a strong emphasis on collaborative learning.

B. Collaborative learning

Students learn best when they are actively involved and engaged in the learning process. In educational environments, study groups are often formed to gain better insight on course topics through collaborative efforts. Collaborative learning is defined as the grouping and/or pairing of students for the purpose of achieving an academic goal [18]. Davis reported that regardless of the subject matter, students working in small groups tend to learn more of what is taught and retain it longer, than when the same content is presented in other more traditional instructional formats [19].

Supporters of collaborative learning suggest that the active exchange of ideas within small groups not only increases interest among group participants, but also helps to improve critical thinking skills. The shared learning environment allows students to engage in discussion, take responsibility for their own learning, hence becoming critical thinkers [18]. Students are responsible for their own learning as well as the learning of others. Research has shown that collaborative learning encourages the use of high-level cognitive strategies, critical thinking, and positive attitudes toward learning [20]. Further, it has been suggested that collaborative learning has a positive influence on student academic performance [16].

V. COURSE DESCRIPTION

The description of the course, *CSCI 440 – Human Computer Interaction*, which is set to be offered during the 2012-2013 academic year, is to provide students with an introduction to human-computer interaction and to expose them to current research topics within the field [21]. The perquisites for the course include successful completion of *CSCI 220 – Programming II and IT 325 – Web Systems Design* or *CSCI 230 – Data Structures*. The prerequisites were chosen to ensure that students had some experience with structured programming and scripting languages; and, that they had completed many of the general university requirements, where some of the concepts from these courses would be used in the HCI course.

The course outcomes describe the specific knowledge and skills that students are expected to acquire. The course outcomes for *CSCI 440* include the following, and at the end of the course a student should be able to:

- Clearly state the multi-disciplinary nature of HCI and its origin.
- Identify the different areas of study within and current research topics related to the HCI discipline.
- Identify the basic psychological and physiological attributes of computer users.
- Describe and identify the components and devices of computer systems.

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- Describe the fundamentals of the HCI design process.
- Explain how technologies help organizations/individuals meet their goals.

To meet the objectives of the course outcomes, the content of the course included:

- Introduction to HCI
- The Human Component of HCI
- The Computer Component
- Interaction Basics
- The Design Process
- Evaluative Techniques
- Current Topics in HCI

Table II is an outline of the topics covered during the sixteen week semester [21].

TABLE II. – COURSE SCHEDULE

Week	Topic
1	Introduction
2	Historical Perspective of HCI
3	The Human
4	The Human
5	The Computer
6	The Computer
7	The Interaction
8	The Interaction
9	*Spring Break – No Class*
10	Interaction design basics
11	Design rules
12	Evaluation techniques
13	Evaluation techniques
14	Universal design
15	Universal design
16	Putting it all together

Learning resources may be of the following two broad types: (a) lecture materials; and (b) development or modification of class projects and descriptions. Lecture materials introduce specific concepts, terminology, and techniques to the students in the classroom. Class projects are often used to reinforce student learning. The next section presents a description of the class projects, the paper in special topics, and the in-class debates on case studies, which are all used to assess student learning. Also, presented is how each assessment has been designed to reinforce the theoretical concepts taught in class.

VI. STUDENT ASSESSMENT

A. Class Projects

Three class projects were re-designed. Each project was named for a popular television show. Students are required to complete each project according to the stated specifications and then provide a written report and to present the result of the project during the class hour. The names of the projects are:

- Designers' Challenge
- Design on a Dime
- America's Next Top Model

This section discusses the projects in detail.

1) *Designers' Challenge*

The purpose of *Designers' Challenge* is to allow students to use their creativity to redesign an indirect input device. The specifications for this project include developing a prototype or mock-up of a hand-held device that could be used by *United Parcel Service of America, Inc.* (UPS). The following fictional scenario is provided for review by the students:

> Mangers at UPS have noticed that it takes a delivery person approximately 10 minutes to deliver a package, which includes having the receiver sign for the package. Managers have also noticed that it is the signing for the package by receivers that takes the longest amount of time and results in the largest number of errors. Often, customers want to chat with the UPS employee and forget to sign for the package, the UPS employee forgets to charge the device, or the UPS employee injures his or her hand when handling the device as well as the package. Therefore, to minimize error rate and to improve performance, UPS has enlisted a company to redesign their current input device receiving packages, which is an electronic signature board and pen, to a new and improved device using the latest technology for the UPS employee to use to capture the signature of the receiver of the package.

Also provided are the following fictional general requirements:

> The device cannot be any larger than one 8½ X 11'' sheet of paper and no smaller than the size of regular-sized PDA. The device must not weigh more than one (1) pound. Anything else would be too heavy for the UPS employee and the receiver of the package to use. The device may use text entry or a positioning, pointing, or drawing device.

2) *Design on a Dime*

The purpose of the *Design on a Dime* exercise is to allow students to design the interface to a device. Students are required to supply the following:

- A persona that describes the core user group
- A scenario that describes an example of how the ordering tool will be used
- A network diagram that illustrates the main screens or states of the ordering tool
- A functional prototype of the ordering tool

Students are given the following fictional scenario:

> A new Apple store is coming to town. Apple expects the store to be wildly popular since it will cater to the more

than 3000+ students, faculty, and staff at Tuskegee University. To get the store up and running it has decided to allow students in the *CSCI-440* class to design an interface for its new inventory tool.

3) America's Next Top Model

The purpose of this project is to allow students an opportunity to use the experimental evaluation techniques discussed in class to analyze and assess user interaction with software. Students are required to select two popular search engines currently being used and to conduct an experimental evaluation to determine if the products are successful according to today's users. The method that students are encouraged to use, include the following:

- Choose at least six but no more than ten of their peers to participate in the study
- Develop a series of tasks that each person is to perform
- State two hypotheses that can be tested
- Use statistical tests to display results
- Use descriptive statistics to make inferences about the population

The written report must include the following:

- A statement of the problem (purpose of the study)
- An introduction to the search engines
    - Important features of each
    - Illustration of each
- A description of the evaluate technique used, including the stated hypotheses
- Results
    - Description of the population
    - Descriptive statistics describing results (i.e., charts, graphs)
- Discussion of results and concluding thoughts
- An appendix containing the hard copies of the end user survey

B. Collaborative Learning

The premise of the collaborative learning was to expose students to current case studies in the field and then allow them to discuss the pros and cons of the case studies. In the field of software security it has been stated that case studies provide an opportunity to review the practical aspects of software security [17]. Therefore, this concept was applied to HCI as it relates to current IT trends.

The directions stated that the student should do the following:

- Analyze the situation
- Use analogies and similar cases where possible
- Identify possible risks or consequences
- Discuss how the new technology changes the situation, if relevant
- Discuss the advantages or problems resulting from using the "new and now" technology and compare it to the "old and then" use of technology
- Present your opinion of the situation

Additional directions include that the presentation of each student team should be no less than fifty minutes in length which covers the entire class period. Each team is also required to submit a typed-written paper, not to exceed one (1) page, which includes the aforementioned points. The paper must include at least three (3) references from which the information was gathered.

C. Special Topics Paper

Students are to select any current topic in the field of HCI to research, which is not presently covered in class. Students are required to write a research paper on the topic and to present the paper in class. The paper has to be type-written and between eight and ten pages in length. Additionally, students are required to follow either the *IEEE Computer Society Style Guide* or *The Publication Manual of the American Psychological Association*. A list of research papers is made available to the students along with suggested topics for presentation.

The aim of the technical-writing component allows students to practice their technical writing skills as well it reinforces the concepts of writing a technical literature review. Lastly the special topics paper also allows students to choose a topic of their interest and present the concepts not previously explored in class.

VII. CHALLENGES

The author encountered several challenges in re-designing the course. The first challenge that the author faced was course enrollment and constituency [22]. Although originally designed from a multi-disciplinary perspective, the overwhelming majority of the students enrolled in the course were computer science and engineering majors with a very small sprinkling of social science majors. The original course was designed to take advantage of students' skill set in programming, technical writing, and math (as it relates to statistical analysis). Therefore, to meet the needs of the needs of the original constituency group and the new IT majors, it was decided that the course would still be taken by students at the senior level, but the prerequisites would change to include those with programming experience in structured and or scripting languages. It was further decided that keeping the course as a senior level course would ensure that all had completed general education university requirements, ensuring the multi-disciplinary scope of the course.

The next challenge the author faced was deciding on the content for the course projects. The author wanted to ensure that information technology students who would be well-grounded in application development tools and web systems

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design would be comfortable alongside their computer science counterparts who would be well-grounded in theory and programming and vice-versa. Therefore, it was decided that the projects would remain multi-disciplinary in nature, but would also encompass business principles.

Lastly, the author wanted to ensure that students left the course understanding the current topics in the ever-changing field of technology. Therefore, it was decided that the best way to engage students in this area is through the current topics paper and through the collaborative learning exercises.

VIII. CONCLUSION

The aim of this paper was to present a re-designed undergraduate human computer interaction course for a newly developed information technology major leading to a bachelor's degree in information technology. The paper provided a high level overview of the teaching pedagogy selected for the course, a description of the course and the assessment methods chosen to examine student learning. Also, presented are certain challenges the authored encountered in further revising the course for an even more multi-disciplinary audience.

As technology increases in complexity and users demand more from their technological systems, it is imperative that academia continue its dominance in training the technologists of the future. As educators, we must provide students with more options to gain entrance into the technology race besides the traditional engineering and computer science tracks. The broad discipline of Information Technology allows students to gain an understanding of how to meet the needs of the diverse user by merging the technical side of computing with its humanistic side. From ergonomics, to human factors, to the human computer interface and beyond, the influence of humans on technology is persistent but also ever-changing creating a dynamic interplay somewhere between humans, computers, and their interaction.

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