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Abstract

Human-Computer Interaction (HCI) is an important knowledge component for graduate IS and E-Commerce (IS/EC) programs. HCI topics, such as user-centered design and usability testing, are particularly critical to the development of Internet-based solutions, but have not yet gained enough attention in graduate IS/ECT programs. In this paper, we discuss HCI-related learning objectives and alternative approaches to incorporating HCI topics in graduate curricula. Through a case study of our own experience, we illustrate how HCI topics can be taught as a stand-alone course or in existing IS/EC courses. We further address pedagogical challenges regarding student skill sets, learning outcomes, innovative pedagogy, tools and technology, and HCI issues for advanced IS/EC topics.

Keywords: Human-Computer Interaction (HCI), usability, e-commerce, IS curriculum, user-centered design

Introduction

The Web is becoming a common platform for delivering interactive applications for customers, and for supporting inter-/intra-organizational processes. In this environment, HCI topics, such as user-centered design and usability testing, are critical to Internet-based solutions (Lazar et al. 2002). Some model curricula of IS have started to address HCI issues (Lidtke et al. 1999; Gorgone and Gray 2001). However, a cursory review of Master level IS/EC programs shows that only a few programs offer stand-alone HCI courses or incorporate these topics in existing courses. In this paper, we address the role of HCI in Master level graduate IS/EC programs and two ways to help graduate IS/EC students acquire better understanding about HCI issues. One approach is to offer a stand-alone HCI course. Another approach is to incorporate HCI topics in various existing courses. Through a case study, we illustrate how these approaches have been implemented in a Master of Science program in E-Commerce Technology at the School of Computer Science, Telecommunications, and Information Systems at DePaul University. We further address pedagogical challenges in teaching HCI topics to graduate IS/EC students. These challenges include student skill sets, learning outcomes, innovative teaching methods, tools and technology for supporting HCI teaching, and topics of emerging importance.

HCI in Graduate IS/EC Curriculum

Employers expect IS/EC graduate students to be trained to make critical business and technology decisions when they take on the roles of analyst, developer, IT manager, and project leader (Lidtke et al. 1999). Clearly, usability is one criterion that cannot be ignored for software products (Vredenburg 1999; Madsen 1999; Rosenbaum et al. 2002). It is therefore essential to address the awareness of usability and HCI-related issues in IS/EC curriculum.

HCI has emerged as a research focus with organizations, journals, and conferences devoted exclusively to this topic. Recognizing a need to educate students in this field, in 1988 the ACM Special Interest Group on Computer-Human Interaction (SIGCHI) created a Curricular Development Group whose goal was to produce a set of recommendations for teaching HCI. In 1992, this group published the *ACM SIGCHI Curricula for Human-Computer Interaction* (Hewett et al. 1992). In this publication, they laid out a basic approach to HCI education, including learning objectives and goals for content coverage. The group identified 12

learning objects shared by all survey courses in HCI (see Figure 1). In terms of content coverage, students should be expected to recognize and recall pertinent terminology, use concepts to explain and analyze specific situations, and apply these concepts in solving problems in real-life scenarios.

The student should become familiar with

1. The scope of issues affecting human-computer interaction,
2. The importance of the user interface to motivate the study of topics like HCI and user interfaces,
3. The impact of good and bad user interfaces,
4. The diversity of users and tasks (applications) and their impact on the design of user interfaces,
5. The limits of knowledge of individuals developing HCI systems,
6. The need to work with others, skilled in diverse areas such as software engineering, human factors, technical communication, statistics, graphic design, etc.,
7. Cost/benefit trade-offs in HCI design,
8. Different system development life cycles including those particularly applicable to HCI systems (e.g., iterative design, implementation, evaluation, and prototyping),
9. How HCI concerns can be incorporated into systems development life cycles,
10. The need to evaluate system usability (e.g., someone will evaluate usability even if not the developer, and, in some cases, not evaluating constitutes professional misconduct),
11. The existence of design, implementation, and evaluation tools for developers with diverse needs and technical expertise, and
12. The information sources available on HCI.

Figure 1. The Learning Objectives Shared by HCI Courses (Hewett et al. 1992)

In the current stage, some model curricula of IS have started to address HCI issues. HCI is an important knowledge component in both the *Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems* (MSIS 2000) presented by ACM and AIS (Gorgone and Gray 2001) and the *Information Systems-Centric Curriculum* (ISCC '99) (Lidtke et al. 1999). The MSIS 2000 curriculum identifies human factors as a career elective course. The ISCC '99 curriculum reflects the perspectives of industry practitioners. It emphasizes human behavior and computer interaction as an industry defined attribute of an IS graduate, and HCI as one of the knowledge components. Its proposed course on HCI draws largely on the themes of the 1992 SIGCHI *Curricula for Human-Computer Interaction* (Hewett et al. 1992), including:

- The diversity of users and tasks, and their impact on design.
- The cost-benefit tradeoffs in user-centered design.
- How user-centered concerns can be incorporated into system development life cycles.
- he need to evaluate system usability.

In contrast, HCI is absent in the *Curriculum Model 2000 of the Information Resource Management Association and the Data Administration Managers Association* (Cohen 2000). The IRMA/DAMA curriculum model focuses on managerial perspectives in organizing the knowledge components required for the management of information and technology resources. Information users are identified, but not in the specific context of HCI as defined in the ACM SIGCHI framework.

To understand the role of HCI in graduate IS/EC programs, we conducted a cursory review of the 141 Master level MIS programs listed in ISWORLD (http://www.pitt.edu/~isprogs/graduate.html). In examining the online course descriptions of these programs, we found relatively few programs with designated HCI courses. These programs tend to be housed in schools of information science (for example, Indiana University, Syracuse University, and University of Michigan) or computer science (for example, DePaul University). An alliance with an HCI program in a different school may also be a factor (for example, Georgia Institute for Technology). However, most graduate MIS programs only mention user interface design as a topic in traditional systems analysis and design courses. Similarly, e-commerce programs and courses as listed in ISWORLD tend to focus on strategies and business models. Few programs incorporate HCI issues in e-business courses. The managerial and strategic focus of these programs leaves little room for HCI-related topics. While these programs may expose students to Internet technologies and Web authoring tools, they do not specifically addresses HCI issues. For programs that prepare graduates for project management, analysis, and application development, this omission is problematic. Therefore, methods for integrating HCI topics into existing curricula deserve thoughtful consideration and creative strategies.

HCI Topics

The three published curriculum models as discussed above (MSIS 2000, ISCC '99, and ACM SIGCHI) have identified topics for a complete curriculum as well as for a single HCI course. In light of the gap between expert recommendations and the level of implementation across graduate IS/EC programs, we believe a more pragmatic approach should be considered. The wide adoption of the Internet and the Web as a common platform for service and information delivery are further evidence that a graduate IS/EC program should cover the following HCI topics:

> *The importance of interface design and cost effectiveness analysis of user-centered design*. How should interface design and usability testing be incorporated into the development process? These topics can be included in systems analysis and design courses of IS/ECT.
>
> *A survey of methods frequently used by the HCI profession, such as usability testing and prototyping*. Because most IS/EC students will not become HCI professionals, it is not necessary to cover these methods in great depth. While they are not likely to perform these tasks by themselves in their jobs, they should be able to apply their knowledge to justify the necessity of employing any of these HCI methods.
>
> *Design guidelines*. The discussion of general design principles and how to use design guidelines provides students foundational knowledge about interface design. The guidelines should cover a wide range of issues including accessibility and trust.
>
> *Usability for Web site engineering*. The focus on usability issues should focus on Web-based solutions, but students should also have some exposure to the usability of general software products.

Approaches for Integration: A Case Study

To incorporate HCI topics into IS/EC curricula, we suggest a combination of the following two approaches:

- Create a required HCI course that covers a broader range of topics. This course could be designed as an introductory course presuming no prerequisites.
- Incorporate key HCI topics, such as usability testing and user-centered design, in existing courses in Web design (Lazar 1999), information systems (Khoo 1999), and e-commerce (Villiers 2001).

Both approaches would not require the restructuring of an entire curriculum because no specific prerequisites would be required and the discussion of HCI issues could be embedded within existing topics of advanced courses.

We have implemented both approaches in the Master of Science program in e-commerce at the School of Computer Science, Telecommunications, and Information Systems at DePaul University. These courses are open to students majoring in IS, EC, HCI, and Computer Science (CS).

Offer a Required HCI Course

We introduced a required course on *Usability Issues for E-Commerce* in the advanced phase of an EC curriculum at our institution. This course provides an overview of the user-centered development process with an emphasis on Web site design, prototyping, usability testing and special consideration for the novice user. Table 1 presents the topics covered in this course. By using a combination of case studies, discussions of general concepts, and applications to specific problems, this course achieves the goal of covering the four topics of HCI most important to an IS/EC curriculum as discussed earlier.

Table 1. Weekly Topics for *Usability Issues for E-Commerce*

Week	Topics
1	Benefits. User and Task Analysis. Usability Goals.
2	Evaluation. Informed Consent.
3	Usability Testing.
4	Gathering Data. Content Organization. Card Sort.
5	Visual Organization.
6	Navigation. Design Principles.
7	Text. Design Methods. Prototyping.
8	Color. Bandwidth Reduction.
9	Multimedia. Globalization.
10	Accessibility. Trust

The discussion of the user-centered development process includes case studies demonstrating how this methodology has benefited e-commerce sites. Addressing the needs and priorities of novice users is particularly important because Web site users are typically impatient, have a low tolerance for frustration, and are likely to leave a site quickly if they encounter difficulties in finding what they want (Nielsen 2000). Special emphasis is placed on how user-centered techniques can be incorporated into existing development methodologies while keeping the additional impact on resources to a minimum. This course also introduces two Web authoring tools (Adobe Photoshop/ImageReady and Macromedia Dreamweaver). Thus students have an introduction to all aspects of user-centered design as it applies to Web site development.

To unify homework assignments, the instructor gives students a goal of redesigning Web sites that students created in previous courses. Each homework assignment covers a different part of the user-centered design process as it applies to the Web site. Assignments cover user and task analysis, information architecture, screen layouts, and evaluation involving user testing. This includes the card sort technique to discern a user's mental model for content organization, navigation, labeling, and searching systems (Nielsen and Sano 1994; Rosenfeld and Morrille 1998). For the final projects, students choose Web authoring tools and create a redesigned version of the Web site.

Incorporate HCI Topics in Existing Courses

In a core course on *Design and Strategies for E-Commerce*, we incorporate some of the usability issues in the Web site engineering method (Powell 1998). This course surveys B2C e-commerce models and supporting Internet technologies. The goal of this course is to prepare Web developers with hands-on experience in Web site development in the context of B2C e-commerce business strategies. As shown in Table 2, students in this course learn the concepts of B2C business models, consumer behaviors, the e-commerce value chain, online shopping, order fulfillment, digital payment systems, security, marketing, and e-commerce technologies. Concurrently, they apply these concepts in team projects by creating B2C Web sites following the Web site engineering method. Each team develops a business plan, audience profile, information architecture, navigation, programming, prototyping, implementation, and site promotion and maintenance strategies (Chan and Wolfe 2000).

All the teams follow a tight schedule of eleven weeks. Student teams have to meet the requirements of six project deliverables: (a) a team organization statement, (b) a business case statement, (c) a requirement report with an information architecture chart and transaction process flowchart for shopping cart and order fulfillment, (d) graphic design, Web page layout (in sketches), and navigation design, (e) feasibility and implementation plan, and (f) an in-class demo of a fully functional prototype site.

Students learn user-centered design through the course-long project. In deliverable (b) they have to articulate the user profile and intended tasks. In deliverable (c) they learn to produce the information architecture chart based on assumptions or data about users. In deliverable (d) they apply methods for graphic design, navigation, and interface in producing paper prototypes and page layout. However, students often do not perform usability testing because of time constraints. This course exposes students to the full process of Web site engineering with an added focus on user-centered design. They develop an in-depth understanding of the usability testing process and techniques in the *Usability* course.

Table 2. Weekly Topics for *Design and Strategies for E-Commerce (Chan and Wolfe 2000)*

Week	Topics	Project Deliverables
1	EC Framework. Web Site Engineering.	A. Team Organization Statement
2	EC Value Chain. Internet Consumer Behaviors. B2C Value Propositions.	
3	B2C Business Models.	B. Business Case Statement: Value Proposition, Business Models, Market Analysis, and Intended Users
4	Online Transaction. Shopping Cart. Usability. Requirement Analysis. Information Architecture.	C: Requirements and Information Architecture Chart, Process Flow Chart, Page Definition
5	EC Technologies. Interface and Navigation Design.	
6	B2B and Intranets. Prototyping.	D: Detailed Design, Site Layout (sketches), Graphic and Interface Design, ERD
7	Transaction Security. Digital Payment.	
8	Marketing, Promotion, and Maintenance of Web Site. Personalization. Search Engines. Site Usage Analysis and Metrics.	
9	Implementation. Globalization and Legal Issues. Feasibility.	E: Feasibility Report.
10	Future Trends.	
11	Presentation.	F: Final Project

Additionally, we incorporate HCI-related topics in a course on *Advanced Topics for Server-Side Scripting.* This advanced course covers n-tier design, COM components, and other scripting techniques. Besides covering technical issues, the instructor introduces discussions on usability issues in several ways. In the discussion on tiered design, students learn that separating the interface layer from other layers makes it possible for interface designers to get involved in the early stage of development. Later, students learn how to use COM components in order to better comply with certain usability guidelines. For instance, interface features implemented by COM components can result in higher consistency. The pervasive discussion on HCI topics in the curriculum enhances student learning by emphasizing the linkage between HCI and IS/EC.

It is essential to continuously incorporate HCI-related discussions in advanced IS/EC courses, such as project management, Web data mining, intranet and extranet development, and systems analysis and design. Through case studies in a project management course, students can examine the process and challenges of developing Web-based solutions through collaborative teamwork and the roles HCI professionals play in application development. In a Web data-mining course, students can apply HCI principles to customize information presentation, search, and interface design based on user profile and data from collaborative filtering. In the development of intranet and extranet systems, students can apply design guidelines and usability testing to enterprise portals, and more data-centric Web sites in contrast to Web sites for consumers.

An IS course on systems analysis and design is a natural place to address HCI topics. User and task analysis, interface design, and prototyping are congruent with system development life cycle (SDLC) and rapid application development (RAD) methods. However, traditional systems analysis and design courses and textbooks tend to focus primarily on process and data modeling methods from a business and organizational perspective. HCI topics are addressed mostly in the interface design stage. As the Web becomes a prevalent vehicle for information access and exchange, it is important for analysts and developers to understand HCI approaches and user-centered design. Therefore, SDLC can be augmented with user/task analysis, information architecture,

paper prototyping, and usability testing. Incorporating these HCI topics requires rearranging the topics currently covered in systems analysis and design courses.

Pedagogical Challenges

Teaching HCI in graduate IS/EC programs presents many challenges. Drawing from our own experiences and experimentation since 1999 (Chan and Wolfe 1999), we examine these challenges and offer suggestions regarding students, learning outcomes, innovative pedagogies, tools, and technology.

Student Skill Sets

IS/EC students typically possess a strong aptitude toward business strategies, systems analysis and development, coding, and databases. Yet, often they are weak in visual design, cognitive psychology, or patience for the iterative design process. They tend to approach design and analysis from a broad organizational perspective, rather than a user's perspective. These students typically are capable of following the phased approach of SDLC, but have trouble adjusting to the loosely structured collaborative environment of HCI. When teaching HCI topics, this general profile of IS/EC students should be taken into consideration. The instructor needs to compare the value propositions for users to those for the organization. For team projects, students of complementary skill sets should be assigned to the same team.

Teaching Evaluation First

An instructor should introduce evaluation methods before design in order to compensate for the students' lack of basic HCI skills, and motivate their study of usability and user-centered design. For example, an instructor can start off a course with an assignment evaluating existing Web sites. Witnessing a series of users struggle with a site helps to convince students of the importance of usability. Students also learn from redesigning existing Web sites with poor usability.

Leveraging Student Skills

When a course is open to majors from different disciplines, such as HCI, IS, EC and CS, the instructor can leverage the different strengths these students bring to a project team by emphasizing collaborative teamwork (Chan and Wolfe 2000). This requires a clear definition of roles and responsibilities necessary for a collaborative team. Students from different academic fields exhibit different approaches to problem solving. The instructor should also set clear criteria for team composition, especially in the cases of self-selected teams, to ensure diversity and complementary skill sets.

Placing HCI Courses Early in the Curriculum Sequence

A separate HCI course should either be placed as a prerequisite course or immediately after a Web site engineering course, like the *Design and Strategies for E-Commerce* course discussed earlier. A prerequisite HCI course provides a solid foundation for helping students to focus on needs of the individual users and the process for supporting user-centered design. While this would improve the learning outcomes of a Web site engineering course, some students may want to have a broad business context first. When it is placed immediately after a development course, this course can cover HCI topics in greater depth, but students may be anxious to skip tasks in order to acquire hands-on experience. Therefore, this course should not be placed too late in the curriculum track. Placing this course too far into the program of study diminishes its benefit for technically oriented students, because they may have already formed bad habits that will deter their understanding of HCI techniques.

Learning Outcomes

The study of usability testing and user-centered design emphasizes the iterative process. However, IS/EC students tend to value tools and implementation more than the process. This can often be seen in their tendency to bypass paper prototypes and go directly to producing a high-fidelity prototype. Since many easy-to-use tools are available for producing templates and visual design, students may feel more gratified by computer-generated output. However, doing so may cause students to lose focus on how to draw conclusions from qualitative and quantitative evidence for building the next tasks. It is important for the instructor to keep this in mind while teaching HCI topics to IS/EC students.

The Web is an excellent vehicle for studying and practicing user-centered design. It is usually easy to build testable prototypes quickly. Because Web sites share many properties with other interfaces, these lessons translate well into other areas of software development. We recommend three methods for achieving the desired learning outcomes.

Making Learning Outcomes Tangible

An instructor should structure learning outcomes into tangible deliverables. The most natural deliverables are the artifacts that would arise from engaging in the user-centered development methodology. For example, an HCI course can include assignments on user and task analysis, where students report on their interviews of users. Another important deliverable is a usability report which summarizes the result of user testing of a Web site. Other deliverables arise from card sorting for content organization, visual design for navigation, and user prototyping.

Emphasizing Process

For many technically oriented students, a course based on process instead of end results can be a new experience. To foster student learning of the process and concepts, short in-class exercises and homework questions should accompany course-long projects. In the case of conducting a user test, it is important to grade students on their preparedness and professionalism when they conduct the test, not in the number or quality of the findings they produce. To encourage students to prepare thoroughly for user testing, the instructor posts the detailed checklist that is used while observing the students conduct the test.

It is essential that students learn that users must be involved in Web development. It is not possible to design a site in a vacuum. For this reason, it is important not to grade a Web site as an isolated homework or project, but to determine its usability through user testing. To provide the most valuable learning experience, it is best to grade students *not* on how well the users perform during user testing, but on what students choose to do with the results of the user testing.

Designing Special Assignments

An instructor should design special assignments or exercises to link HCI principles to advanced application development. This will reinforce student knowledge and HCI skills. For example, an assignment in a security course can consider the issue of how best to let a users know that they are actually using a secure site, and how best to ease their concerns for using their credit cards safely. When developing a set of JavaScript menus, ask the students to conduct a card sorting exercise to best determine the structure of the menu content. Another possibility is to conduct a task analysis and compare the results with click stream data while developing personalized Web pages.

Innovative Pedagogy

An interactive and collaborative approach to teaching HCI facilitates student learning. This approach involves team projects and a studio environment that will be discussed in greater detail below. Team projects resemble the collaborative nature of usability testing and user-centered design. The studio method supports the teaching of graphic design. Here we focus on three specific innovative pedagogies.

Collaborating in Teams

We have used a collaborative team learning approach for several terms to pair the *Design and Strategy for E-Commerce* class with an *HCI Usability* class, for HCI majors only (Chan and Wolfe 2000). A pair of project teams, one from each class, was formed for collaboration. The teams from the e-commerce class played the role of Web developers. We synchronized the course schedules and assignments between these two classes to facilitate the collaborative process. Each of the first four deliverables listed in Table 2 served as input for HCI consultants to perform usability tests. Thus the consultants could perform user/task analysis, card sorting, interface design, and usability testing on both a paper prototype and the final Web site. Results of usability tests helped the developer teams to improve the results of their final project.

Working with Real Clients

Working with real clients is well worth the time and effort involved. Students gain valuable experience in learning how to translate user/task analysis into requirements, and to negotiate with clients about site design. In this way, they will focus on meeting potential users needs as opposed to the client's. For example, in one case students were challenged to redesign the Web

site of a local chapter of a national non-profit organization. They had to achieve consistent branding and design while improving the site's usability within many constraints imposed by the organization's main site. Working with non-profit organizations presented different challenges from working with commercial or corporate clients. Students learned to focus on novice users as well as organizations with less technological savvy. Design and usability decisions had to sustain waves of progression as the organization and its staff went through their learning curves.

Applying the Studio Method

Graphic design is important in Web site design because it is the foundation for arranging content on pages in an aesthetically pleasing way that also facilitates user navigation. Teaching graphic design is done with the studio method. Students are given some background material on a subject and handed a free-form assignment. Effective pedagogy fosters a culture of encouragement, and shows students that it is safe to try new ideas. Students will usually have widely diverging solutions to the same design problem. This is the best part of the process - seeing that there are many different approaches to design. The instructor's background and experience are more usefully deployed after students have sought design solutions on their own. In the studio method there is no single best answer. Educators in art and architecture, who have struggled with the pedagogical problem, have found that this is the best way to teach design (Crinson and Lubbock 1994). The studio context encourages feedback and critique so that students experience the roles of both user and evaluator of an interface (Strong 1994).

Tools and Technology

Courses as proposed in this paper should provide laboratory or studio opportunities for students to gain experience in putting theory into practice. Such effort will require special facilities, tools, and technology.

Studios and Labs

Facilities play an important role in facilitating teamwork and emulating real world design experience. A studio environment encourages students to work in small groups and critique one another's work. A studio suits graphic design. A laboratory with workstations arranged in clusters, with space for teamwork, is the most desirable layout. The lab naturally groups students into teams and is suitable for prototyping and user testing. With proper facilities, the learning of students can be effectively enhanced.

Software

The software packages supporting these courses should include Microsoft Visual Studio, Microsoft Office 2000 with FrontPage, Macromedia Dreamweaver, and Adobe PhotoShop. Dreamweaver is used primarily for prototyping and layout design. PhotoShop is used for graphic design. Fireworks and Flash are useful for advanced development. We discourage students from using these packages in introductory courses in order for them to first focus on the basic principles and tasks.

Implementation Tools

With Web design, HTML plus a Microsoft-based scripting technology such as ASP or ASP.NET is a good choice for students practicing high-fidelity prototyping and usability testing. The scripting technology is easy to learn, effective, and also widely available. Web authoring tools that incorporate server-side scripting are also useful.

Special Tools

We also use software, developed by a doctoral student, to automate the card sorting process. Using this software, students can create and display content items online instead of using 3x5-inch index cards. Representative users participating in card sorting can arrange content items into groups of related items and give each group a label. The software records the results for each user testing and analyzes the results for patterns of clustering.

Advanced Topics

Several advanced HCI topics, such as globalization, personalization, disabilities, and wireless strategies, are of increasing importance to Web development. Introductory courses do not usually cover these topics in depth. However, a strong grasp of the implications of these issues for usability will enable developers and designers to produce more effective Web solutions.

Globalization
Coordination between the internationalization and localization of content, design, and usability is essential for global site development, as seen in sites for IKEA (www.ikea.com) and United Air Lines (www.united.com). However, it is difficult to find projects or assignments for students to practice these development techniques. Approaching this topic works best when students have ready access to people who grew up in a culture other than the U.S. Having a class with students from different cultures is a rich opportunity for discussing this topic. As a simple class exercise, ask students to write down the cultural meaning for the colors red, white, green, yellow, and black. Once the students have completed the survey, they will tally the responses, and discuss the results. Another possible homework exercise is to ask students to investigate Unicode and localization options on their computers and to configure a browser to correctly display pages that are written in such languages as Arabic, Japanese, and Chinese.

Personalization
Beyond simple design using cookies and session variables, personalization will be an important mechanism to customize the content and services that will build relationships with customers, employees, and users of different preferences. Students can benefit from applying various personalization mechanisms to customize content and services. Any sort of personalization will be ineffective without in-depth knowledge of the people who use the Web site. This is an opportunity for conducting task analysis.

Disabilities
Universal access is often left toward the end of a Web development or a usability course. Input and output devices beyond the Web will become important considerations in the near future. The World Wide Web Consortium's web site (www.w3.org) is a rich resource for information on how to make a Web site more accessible to people with special needs.

As an exercise, have students experiment with screen readers. Ask students to complete a few simple tasks on their Web sites with a screen reader turned on and the computer monitor turned off, and have them report on the results. Many people with severe motor disabilities browse the Internet by using adaptive pointing devices such as a head wand or a switch coupled with an onscreen keyboard. These people do not have access to a mouse. Ask students to complete several tasks on their Web sites without using a mouse to verify that it is possible.

Wireless
Mobile Internet and wireless technology will significantly alter the way users interact with the information. Limitations in the current state of wireless technology poses many constraints for designing effective user interface for wireless applications. Small screen display, limited bandwidth, and the simplistic yet diverse functionality of wireless handheld devices affect usability (Chan and Fang 2001). Usability guidelines for wireless devices have not yet firmly established. For developing wireless applications, students need to focus on requirement gathering, user and task analysis in the mobile and stationary contexts, content presentation, search and navigation, and interface design to support multiple form factors and in a multi-channel environment (Chan et al. 2002).

Conclusion

The IS/EC faculty has begun to recognize the importance of HCI. The formation of an HCI special interest group within the AIS organization is a clear indicator. Therefore, how to integrate HCI topics in established IS/EC programs is a timely topic for deliberation and exchange among IS academicians. In this paper, we highlight the importance of HCI in graduate IS/EC curricula from the perspectives of student career preparation and industry needs. Institutions can try various approaches to introduce HCI topics, either in a separate new course, or in existing IS or EC courses. There are numerous challenges in such endeavor. How to map pedagogies, learning outcomes, and student skill sets presents opportunities for innovation. Effective HCI instruction also requires studio environment, laboratory and software support. Development for Internet solutions to support personalization, universal access, global markets, and wireless purposes will demand further consideration of HCI issues. Further research and exchange among IS, EC, and HCI faculty is essential.

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