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Methods for Evaluating Interface Design for Online Learning Environments

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Designing online learning environments poses many challenges. One critical issue is the design of appropriate user interfaces so that the interface does not become a barrier to the learning process. The interface of a web site may be described as the sum of the visible (and/or audible) elements which convey to a user what functions and resources are available at the site and provide access to, or control over, those functions and resources. The interface is a key element of usability, where usability means the ease or difficulty with which the user can complete the intended tasks. Following a brief discussion of the context in which instructional web site evaluation has evolved, this paper will discuss four techniques the authors have found useful. These are use of an heuristic during the design process, use of target participant interviews, use of a participant response form, and usability testing.

Interface evaluation in context

Interface evaluation in the context of general software development has decades of history, and well-established procedures and standards. The literature of Human-Computer Interaction (HCI) provides an overview of what both the process and the product of interface design should look like.

The starting point for the interface design "process" should be the intended users' needs and preferences. Laurel (1990) writes: "We continue to demonstrate to ourselves -- through both our successes and our failures -- that the first and most important question to ask is, what does the user want to do?" (italics in original) (p. xii-xiii) The interface design process is described (Hix and Hartson 1993, Mandel 1997) as an iterative process of design and evaluation that should involve user input at the following points:

1. As the first step of the design process, prospective users should be asked to identify tasks they need or would like to perform at the site.
2. Testing with representative users of specific interface elements and layout designs should begin as early as possible. The use of paper mock-ups and rapid prototypes is recommended for testing of early design choices, in order to minimize the amount of coding that must be undone in the event of negative user

responses.

     3. Testing of the site as a whole should begin as early as possible, to see how users respond to the complexity of the whole.

The steps detailed above can be operationalized by development and use of the following:
     Protocols for interviewing prospective users and/or for observing task performance;
     Surveys of potential users to identify desirable site features;
     Usability testing protocols and scripts;
     Survey forms designed to elicit user responses to the interface and its features.

Usability testing is the process of observing and analyzing the behavior of users as they interact with the interface or a simulation incorporating its key features. A commonly used definition of usability is that of Shneiderman (1992), who describes usability as a combination of:

- Ease of Learning
- High speed of user task performance
- Low user error rate
- Subjective user satisfaction
- User retention over time

Usability testing is usually viewed as the process of examining the interface of a program or device for the above characteristics.

     While the process of interface development and testing described above is certainly the ideal, two factors often work against its use with respect to web sites: first is shortage of time. Web site developers are often under pressure to have sites operational quickly. Second is the emergence of *de facto* standards based on the use of a limited number of platforms and browsers. The user typically has acquired a degree of skill in using either the Windows or Macintosh operating environment and either the Internet Explorer or Netscape browser. With these skills, the user has developed certain expectations. For example, the user expects that a file menu will always be available, whose controls are at the top left corner of the active screen, and this menu will contain options at least for printing and saving the page currently before the user. The user also expects that an underlined phrase on a web page will be a link to another page (or site) containing content related to the underlined text. Nielsen (2000) uses the "shopping cart" present on commercial web sites as an example of an icon that has "morphed from metaphor to interface standard." (p. 188) Neilsen goes on to point out the advantage of such a standard: "The benefits come from consistency, which is even stronger than metaphor as a learning tool. In fact, the user doesn't have to learn *anything* as long as an interface element behaves exactly like the user is accustomed to." (p.188, emphasis in original). The use of such "standards" probably shortens the time it takes for a user to become comfortable in using a web site. Conversely, if standard controls (e.g., the browser's "print" button) are <u>not</u> available, the user must learn an alternate method of achieving the desired result, and the user most also remember <u>not</u> to use the familiar procedures. The interface designer's task is increasingly one, not of designing new and rational ways of

connecting materials, but of integrating standard controls in ways that are relevant to the content at hand.

Interface evaluation factors unique to online learning environments

Procedures and standards for evaluating the interfaces of web sites are by no means so well-established as procedures for evaluating the interfaces of, for example, office productivity software. Usability testing for a word-processing software package would likely involve identifying a common task – say, composing an ordinary business letter – and seeing how quickly users can master the controls necessary to perform that task. The interface design goal in this case is to facilitate easy, efficient, and error-free accomplishment of a specific task.

The kind of "tasks" users perform at web sites may be significantly more amorphous in both purpose and process; the user may wish simply to explore, to price-compare, or to assemble materials on a topic. Speed of completion may not be a relevant measure. This is especially true for websites whose primary function is delivery of instruction. Instructional web sites do share characteristics with all other sites, such as the need for the user to be able to identify and use controls, to navigate easily, and to stay oriented in cyberspace. The tasks performed on the instructional web site may be far more complex than making an online purchase and their time to completion may be measured in hours or weeks rather than minutes. Subjective user satisfaction with the interface is likely to be a highly significant criterion, given the need to attract the user into the site and encourage the user to remain engaged with the site for a significant period of time.

Another difference between instructional and other web sites may be in the degree of user control. When a user accesses a commercial or entertainment website, it is the user's purposes and interests that determine how long the user stays, how the user interacts with the site, and where the user goes from the site. At an instructional web site, the user shares control with the designer and presenter of instruction. The instructional design prescribes activities that the user must complete in order to achieve identified learning objectives. A standard process of instructional needs analysis and design is assumed as the basis for determining these objectives. Danielson, Lockee and Burton (2000) note that close interaction between interface design and instructional design is essential throughout the design process.

The overall organization of the site should ideally have some relationship to the organization of the content to be learned or the learning process. Plass (1998) further contends that the type of cognitive processing the user needs to do in order to master the target content material should influence the type of features selected for incorporation in the interface.

While an interface design process based on user inputs and continuing usability testing may be the ideal, another factor that impacts instructional web site interface design and evaluation is the use of externally-developed instructional environments, such

as Blackboard or WebCT. These packages provide high degrees of functionality but may require sacrificing some degree of customizability. Increasingly, site development is likely to follow a "rapid prototyping" model, in which both packaged and newly-developed components are assembled, tested, modified, and retested until the product works satisfactorily (Tripp & Bichelmeyer 1990; Wilson, Jonassen & Cole 1993). If rapid prototyping is used in site development, the evaluator may take part in testing successive iterations of the site interface as a formative evaluation activity. This is preferable to evaluating the interface only when it has been completed and the investment needed to change it may be impractical.

Evaluation of an Instructional web site interface

The authors are in the course of evaluating a large-scale web site development project aimed at providing professional development to middle school teachers. Evaluation of the web site's user interface was undertaken as part of formative evaluation. Since as noted above, existing procedures for interface evaluation and usability testing may have limited applicability to instructional web sites, the authors experimented with a number of approaches to interface evaluation. Four techniques were found especially useful. The first was use of an heuristic during the design process. In March 2002, during the site's pilot testing phase, the authors performed an interface evaluation study with fifteen middle school teachers and technology coordinators. This study used three further evaluation activities: 1) a one-hour usability test, 2) administration of the Interface Evaluation Survey, and 3) a wrap-up focus group interview.

Design Heuristic: The first technique that proved of value in the interface evaluation process was the use of an heuristic during the design phase. This instrument (available online at http://www.unm.edu/~stars) incorporated items examining factors that both the distance education literature and the web design literature appear to support as "best practices." This instrument was important for two reasons. First, it enabled members of the evaluation team to articulate what they viewed as essential features of a well-designed instructional web site interface. Second, the instrument aided in negotiating shared expectations between the evaluation team and the team developing the instructional web site. In fact, the development team adopted the heuristic as a checklist for use in reviewing page designs.

Usability Test: For the on-site usability test, a co-discovery process was used in which participants were placed in pairs and asked to talk to each other as they explored the site. Dumas and Redish (1993) contend that this technique has advantages over the common practice of asking individual participants to think aloud, in that: "Talking to another person is more natural than thinking out loud alone. Thus, co-discovery tests often yield more information about what the users are thinking and what strategies they are using to solve their problems than you get by asking individual participants to think out loud" (p. 31). The authors' experience confirmed that this procedure was comfortable to the participants.

The fifteen participants in the usability test were divided into seven groups, one of which had three members, so that no one would be working alone. A prepared script was used to initiate the exercise. The script instructed the participants to browse wherever they liked from the site's home page, but to discuss aloud their responses to each page encountered. Participants were further asked to discuss links available from each page, state which link they were choosing and why, and then state whether the chosen link produced the expected results. Researchers from both the evaluation and development teams served as note-takers, and some pairs of participants were also tape recorded during the usability test.

The test produced a flood of useful data with respect to the site's aesthetic appeal, readability, and navigability. Even more interesting, however, were the usability test results as they indicated users' responses to the overall structure and focus of the site. Of seven participant groups, only two selected the same link from the opening page of the test site. This was a link entitled "Sneak Preview." From that page, different links were selected by the two groups. No two groups of participants saw the same pages. (Incidentally, none of the participant groups selected "how to use this site.") Participant comments indicated that the teacher participants were uncertain whether the site was for their use alone, or the use of students, or the use of teachers and students together. These findings were clearly of critical importance and led to a complete redesign of the site. As a sidelight, the findings regarding this site point up the kind of trade-offs that must be made by the instructional and interface designers. It is desirable to allow learners the maximum freedom to learn in the way that is most comfortable for them. However, as this example illustrates, in order to learn efficiently the site user must have some indication of how to proceed and of the relative importance of various aspects of content. It is the instructional designer's responsibility to identify "must-know" content and outline a clear path to its learning. The site designer is responsible for designing the structure of the site and its menus in such a way that the learner is supported in following that path.

Interface Reaction Survey: The Participant Interface Reaction survey was designed to collect user views of interface characteristics such as ease of navigation, clarity of focus and structure, and site technical performance. This instrument (available on-line at Http://www.unm.edu/~stars) was administered immediately after the Usability Test so that participants' responses could be collected before they discussed the site with each other. The survey provided important confirmation of observations during the usability test and additional information regarding navigation tools, structure and organization, resources for learning support, and technical performance and feedback. The philosophical bases for using both the survey and the interviews that followed were the beliefs: 1) that learners are capable of recognizing and describing factors that impact the usefulness to them of a site; and 2) that the views of users who will invest their time at the site should be honored to the fullest extent technically feasible. A technical advantage of using a formal survey is that it can yield quantitative data. Moreover, a written or online survey allows the user to express his or her opinions privately. This may be important to users who would hesitate to be openly critical of a site whose designer was present.

Focus Group Interview: The focus group interview was unstructured, so as to allow participants the freedom to discuss their impressions of the web site. Themes that arose in this interview included: initial impressions of the site, varying opinions about the order of choices offered in the navigation bars, icons used, and audio clips. Teachers were complained vocally about the inability to use familiar browser controls, such as the "print" and "back" buttons at the site. Of particular interest were teacher reactions to the issues of discussion forums and downloading plug ins. Teachers were unanimous in stating that they were unwilling to download plug-ins and updated browser versions just to be able to access a specific learning site. The reason for this was the time it takes to perform such operations, and not the inherent complexity of the process. Time was also the reason teachers expressed reluctance to participate in online conferences.

Just as the survey offered the opportunity for private expression, the focus group offered the opportunity to compare opinions. Teachers seemed to gain confidence in their responses upon finding that their views were shared by other participants, and in some cases a remark by one teacher reminded another of something the latter user had forgotten to mention.

As these examples indicate, each of the different evaluation procedures produced a different kind of information. The heuristic produced information about site technical quality. The usability test revealed how users actually behaved at the site and how well the site structure and organization supported learning. The survey determined how widespread and how strong users' reaction were to specific site features, and the focus group interview yielded information that elucidated the users' experience in their own terms. Each of these forms of evaluation was useful in its own right, but the picture resulting from the use of multiple procedures was probably fuller and more balanced than any of these techniques, used alone, could have provided.

Directions for further study

The authors believe that, while the methods they have outlined above are extremely useful in approaching the evaluation of instructional web site interfaces, there may be other approaches that would yield useful complementary data. The authors are currently investigating the use of logging software to establish patterns of instructional site use. We anticipate that this study will be particularly useful when examined in relationship to learning outcomes. Ultimately, perhaps many aspects of the process of evaluating instructional interfaces can be automated. Computers can, after all, produce records of their users' activities for human analysis in determining such things as what color schemes and font sizes learners prefer. Computers can also create models of their users, based on the users' interactions with the system, and respond according to those models. This opens the possibility that the individual user's preferences in interface design can ultimately govern the appearance and structure of the site with which the user interacts. For now, however, the best hope for the development of optimum instructional web site interfaces lies in the kind of evaluation activities the authors describe, in which researchers and the prospective users of a site are partners.

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