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ABSTRACT

Many educators have explored the World Wide Web, and some are now publishing their own materials for student access. Throughout the brief history of the Web, the overriding educational principle has been to view this resource as a storehouse of information which provides unparalleled avenues of research. The potential for the Web, however, is greater. This article justifies and describes instructional design principles that can be used to transform Web material from simple informational resources to a powerful instructional medium. When properly structured, web pages can guide users through a series of instructional activities that present information, afford practice, and provide feedback to inform users of their strengths, weaknesses, and suggestions for enrichment or remediation. The paper discusses the rationale for web-based instruction, instruction and the Internet, motivating the learner, identifying the material to be learned, reminding learners of past knowledge, requiring active involvement, providing guidance and feedback, testing, and providing enrichment and remediation. The emergence of the World Wide Web, with its easy-to-use graphical interface, has drastically altered the way in which people access information and think about computers. The new methods of delivering and receiving instruction require thoughtful analysis and investigation of how to use the Web's potential in concert with instructional design principles. (Author/SWC)

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Using Instructional Design Principles To Amplify Learning On The World Wide Web

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Abstract

Most educators in this country have heard about the World Wide Web. Many have explored this resource, and some are now publishing their own materials for student access. Throughout the brief history of the Web, the overriding educational principle has been to view this resource as a storehouse of information which provides unparalleled avenues of research. The potential for the Web, however, is greater. This article justifies and describes instructional design principles which can be used to transform Web material from simple informational resources to a powerful, instructional medium.

Rationale for Web-Based Instruction

The use of the World Wide Web is growing at an exponential rate. Estimates range from an increase of 6% (Wiggins, 1995) to 20% (Lemay, 1995) per month. In addition to user traffic, the creation of Web servers, Home Pages, and other digital resources on the Web is similarly expanding. This increase represents a tremendous potential for educators, but the vast majority of Web sites offer little more than semi-structured data.

Web pages have the potential to be more than a compendium of information. When properly structured, pages can guide users through a series of instructional activities which present information, afford practice, and provide feedback to inform users of their strengths, weaknesses, and suggestions for enrichment or remediation.

Developing methods and media to educate students from a distance is not a new idea, and can be traced in the United States back to 1892 at the University of Wisconsin (Rumble, 1986). Reasons for teaching students at a distance are varied, but stem from both interests of the learners as well as the logistics of operating educational institutions. Most institutes of higher education provide educational courses and resources to an extremely wide audience who have a profusion of needs and backgrounds, with many students taking classes while working full-time or part-time jobs, and/or raising a family. As such, constituents often have competing needs for institutional resources in the form of attention, energy, and time.

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Fortunately, many communities and universities are currently undergoing changes in their communication infrastructures which allow them to provide information and instruction to their students beyond traditional means. Allowing students to access course information and instruction on a flexible schedule through telecommunications can help increase the sharing of information and construction of knowledge. If universities value their clients and their needs, it behooves them to offer the best possible instruction, in a highly accessible way, with the maximum flexibility to meet individual needs.

In addition to providing students increased access, many colleges and universities view the provision of courses through telecommunications as a way to help conserve limited resources. In many areas, students drive to campus multiple times each week. Problems encountered during this mass migration include traffic congestion and parking limitations, consumption of limited campus and community resources, and increased pollution. Acknowledging these problems, many schools have implemented programs to encourage faculty, staff, and students to reduce their commuting by taking mass transit or joining car pools. Supplying course material and instruction to students at their homes helps reduce the physical and environmental burdens imposed by student travel.

Using these justifications, institutes of higher education have explored a variety of methods to offer instruction at a distance. In the past these methods have included satellite broadcast, broad-band broadcasts, home-video courses, two-way compressed video, audioconferencing, text-based correspondence courses, and slow-scan television broadcasts. Some universities have also experimented with the Internet as a source of instruction. With the public's new interest in the World Wide Web as a medium, there will undoubtedly be a rush to offer classes using this format in the near future. Unfortunately, few cogent examples of instruction using Web pages exist today.

Instruction and the Internet

Instruction can be defined as a purposeful interaction to increase a learner's knowledge or skills in a specific, pre-determined fashion. In this context, simply publishing a World Wide Web page with links to other pages or other digital sources does not constitute instruction. Instructional sequences usually include at least seven common elements: motivating the learner, explaining what is to be learned, helping the learner recall previous knowledge, providing instructional material, providing guidance and feedback, testing comprehension, and providing enrichment or remediation (Dick & Reiser, 1989). With forethought, each of these events can be incorporated in instruction designed to be delivered on the World Wide Web.

Motivating the learner
Because leaving a Web page is as easy as clicking the mouse button, Web page designers have focused much of their time identifying what attracts and retains the attention of the casual browser. The use of graphics, color, animation, and sound have been used as external stimuli for years to motivate learners, and all can be included in Web pages. Some organizations highlight Web pages with yearly, weekly, and even daily awards for aesthetically pleasing, technically innovative, and generally creative pages[1]. These examples provide new developers with easy access to see what attracts and holds a user's attention. It should be noted, however, that simply adding color and graphics doesn't ensure motivating pages. Like the use of multiple fonts and styles when the Macintosh was first introduced, excess is often counterproductive. Examples of unattractive Web sites are also legion. They can be found through general browsing or by accessing specific locations that compile this information[2].

Identifying what is to be learned
In most cases, it is important to let the learners know early in a lesson what they will be responsible for at the end of the instruction (unless you are working with discovery learning). This helps learners focus on those factors which the instructor deems salient. With the tendency of users to free associate while Web "surfing", and to allow their attention (and learning) to be drawn away from desired outcomes, this is a critical component for instructional developers designing for the Web. While it may be true that learning often occurs serendipitously, without a focus introduced through a listing of outcomes, users may spend too much time in mindless Web surfing.

Reminding learners of past knowledge
Cognitive psychologists generally agree that for information to be retained in long-term memory, learners must construct a memory link between the new information and some related information already stored in long-term memory (Gagné, 1985). For instance, teaching youngsters the rules of cricket can be accelerated by reminding them of their baseball knowledge first, then identifying the similarities and differences between the two sports.

Web pages have an advantage over many other methods of instruction because of the ability to link multiple pages to any site. Multiple pages allow learners with diverse backgrounds and knowledge to choose the most salient link to remind them of knowledge they previously learned before new information is offered. In the preceding example, links could be made to pages describing sports in which teams run to bases (softball or kickball), or in which balls are hit with sticks (tennis or

[1]http://www.highfive.com/, http://wings.buffalo.edu/contest/, http://toocool.com/, http://www.capstudio.com/ippa/award.html, http://www.thoughtport.com/spinnwebe/features/awards.html
[2] http://turnpike.net/metro/mirsky/Worst.html

baseball). By identifying similarities and differences between existing knowledge and the knowledge to-be-learned, students more quickly grasp relevant information.

Requiring active involvement
Most educators would agree that for learning to take place, the learner must actively process and make sense of available information. Generally speaking, a more active learner will integrate new knowledge more readily than a passive learner. Unfortunately, active learning is seldom required when learners access the Web. It's true that a user makes decisions as to which link to pursue, but too often users merely browse information before jumping to another site.

How can we increase the possibility that learners actively process information? One way is to require them to develop an artifact of their learning. Dodge (1995) summarizes eight specific strategies based on work by Marzano (1992) that can be assigned to ensure that learners produce knowledge artifacts. These strategies include requiring learners to either compare, classify, induce, deduce, analyze errors, construct support, make abstractions, or analyze perspectives that they encounter in the course of their Web searches.

Providing guidance and feedback
Guidance and feedback can be provided to users either during their exploration of Web materials or afterward by critiquing the artifacts of their exploration. Since most educators have critiqued products in hard copy or oral form (such as reports, essays, tables, and other knowledge representations), let's examine how on-line guidance and feedback can be constructed with the Web.

Most links on Web pages are shown by highlighted and underlined text in which the text itself serves as a descriptor for the topic of that link. Users of Web pages will tell you, however, that often these descriptors or the links they represent turn out to be misleading or even irrelevant. This may be partially due to the lack of relationship denoted in the link's name or descriptor. A more meaningful system would be to use words such as "example", "non example", "justification" or "relationship" when teaching concepts or principles, "definition" or "mnemonic" when teaching facts, and "shortest path" or "alternative path" when teaching a procedure. These terms provide reasons for learners to choose them based on the type of information they will receive when they branch to those sites.

A second method to provide both guidance and feedback can occur when users are required to make an informed choice among alternatives after engaging a segment of instruction. If these choices are designed to determine appropriate or inappropriate responses by the learner, pages linked to their answers can be used to either reinforce the correct response or, if an incorrect response is chosen, explain the rationale and guide the user to a more appropriate answer or other remediation.

A third, more complex method uses CGI (Common Gateway Interface) codes to provide learners with detailed information and alternative choices. With CGI

scripts, information students place into on-line forms, radio buttons, or check boxes can be compared to preset answers in a database or text file. Feedback can provide individual students with a deeper explanation of their choices and active links which guide them to additional information. These CGI scripts can also be written to capture variables from students, hold them in database fields, and access these fields at a later date. This not only allows the guidance and feedback to become more intelligent (based on individualization), but allows users to leave off and pick up an extended instructional sequence as their scheduling needs may require.

Testing

To ensure students have integrated the desired knowledge, it is useful to assess their learning. This can be done either on- or off-line, through objective or subjective tests, or through development of products or portfolios.

On-line testing can be constructed with CGI scripts similar to those described for guidance and feedback in which information is gathered from students, compared with established criteria in text or database files, and assigning grades and/or providing students with feedback. This can be automated for objective tests, or saved in files for instructor critique if more open-ended questions are used.

Developing learning artifacts can also be done on-line if students are provided with the capabilities of constructing their own Web pages. For example, they could be required to create a WebQuest (Dodge, 1995). WebQuests are inquiry-oriented activities in which players, constrained by specific tasks, access the Web to acquire, integrate, extend, or refine their knowledge. The WebQuest itself usually includes an introduction that sets the stage and provides background information, a task that players find doable and interesting, relevant information sources accessed through Web links, a description of how to accomplish the task, guidance in how to organize the information, and a conclusion to bring closure to their tasks.

Providing enrichment and remediation

The final step in many instructional programs provides learners with either remediation (in areas where comprehension is lacking), or enrichment (featuring associated information which extends or applies their knowledge). If on-line forms are completed, CGI scripts can be coded to provide this additional information to the learner directly or via links to additional sources. Because these scripts can be used to analyze users' levels of comprehension, enrichment and remediation can be formulated for specific individuals. This process should help ensure that learners receive relevant, specific information to match their ability.

Summary

The emergence of the World Wide Web, with its easy-to-use graphical interface, has drastically altered the way in which people access information and think about computers. Methods in which we deliver and receive instruction may also be on the brink of a new dimension. Venturing into this new dimension, however, will

require thoughtful analysis and investigation of how to use the Web's potential in concert with instructional design principles. If these two forces can be integrated, it may produce a distributed, instructional medium with characteristics unlike previous methods of distance learning.

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