REVIEW

A Practical Guide To Developing Effective Web-based Learning

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OBJECTIVE: **Online learning has changed medical education, but many "educational" websites do not employ principles of effective learning. This article will assist readers in developing effective educational websites by integrating principles of active learning with the unique features of the Web.**

DESIGN: **Narrative review.**

RESULTS: **The key steps in developing an effective educational website are: Perform a needs analysis and specify goals and objectives; determine technical resources and needs; evaluate preexisting software and use it if it fully meets your needs; secure commitment from all participants and identify and address potential barriers to implementation; develop content in close coordination with website design (appropriately use multimedia, hyperlinks, and online communication) and follow a timeline; encourage active learning (self-assessment, reflection, self-directed learning, problem-based learning, learner interaction, and feedback); facilitate and plan to encourage use by the learner (make website accessible and user-friendly, provide time for learning, and motivate learners); evaluate learners and course; pilot the website before full implementation; and plan to monitor online communication and maintain the site by resolving technical problems, periodically verifying hyperlinks, and regularly updating content.**

CONCLUSION: **Teaching on the Web involves more than putting together a colorful webpage. By consistently employing principles of effective learning, educators will unlock the full potential of Web-based medical education.**

KEY WORDS: **Internet; medical education; World Wide Web; e-learning; curriculum development.**
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The Internet has changed the practice of medicine, and medical education has not escaped its influence.[1] A recent review found 35 evaluative studies of online interventions in medical education.[2] Since that review more have been reported,[3–6] and published studies likely represent only a fraction of Web-based medical education projects.

Unfortunately, not all educational websites are equally effective.[7] Adult learning theory—focusing on learner involvement in the learning process—has changed medical education over the past 3 decades, but its influence is not yet widespread in Web-based teaching. Alur et al. recently reviewed medical teaching websites for evidence of active learning. Although most sites met criteria for a "general informational website," only 17% had all components of a "learning paradigm" (critical thinking, independent learning, evidence-based learning, feedback) and fewer than 50% met any criteria.[8] Informational websites certainly have their use, but a teaching site will be most effective if it stimulates active learning.[1] While incorporating active learning in an educational website is not difficult, it does require thought and planning.[9]

This article outlines essential steps in the development of Web-based courses or curricula that employ principles of active learning. It will not address technical issues such as Web programming or the specifics of webpage design. The scope of these topics prohibit adequate discussion in this paper (the reader is referred to other sources for more information[10,11]). Likewise, this is not a systematic review of Web-based learning; Chumley-Jones et al. recently performed this task.[2] Rather, this article presents a practical framework for developing effective educational websites by combining principles of active learning with the unique features of the Web (Table 1). We cite literature and personal experience to illustrate and support the concepts presented.

PREPARATORY STEPS

The first four steps should be completed before starting the website design. Although it is tempting to skip these steps, their importance cannot be overemphasized. The success of a Web-based educational intervention rests on thorough preparation.

Step 1. Perform a needs analysis and specify goals and objectives

The first step in any educational endeavor is needs analysis, including problem identification, assessment of learners' needs, and assessment of the teaching environment. Kern et al.'s approach[12] is useful: define the health care problem you hope to address by creating an online course, and identify what is being done and what should be done to address this problem. Describe how the current

Table 1. Ten Steps to Effective Web-based Learning

1. Perform a needs analysis and specify goals and objectives
2. Determine your technical resources and needs
3. Evaluate preexisting software and use it if it fully meets your needs
4. Secure commitment from all participants and identify and address potential barriers to implementation
5. Develop content in close coordination with website design
   - Capitalize on the unique capabilities of the Web by appropriately using multimedia, hyperlinks, and online communication
   - Adhere to principles of good webpage design
   - Prepare a timeline; plan for up-front time investment
6. Encourage active learning—self-assessment, reflection, self-directed learning, problem-based learning, learner interaction, and feedback
7. Facilitate and plan to encourage use by the learner
   - Make the website accessible and user friendly
   - Provide time for learning
   - Motivate and remind; consider rewards and/or consequences
8. Evaluate—both learners and course
9. Pilot the website before full implementation
10. Plan to monitor online communication and maintain the site by resolving technical problems, periodically verifying hyperlinks, and regularly updating content

performance of your learners (knowledge, skills, attitudes, and behaviors) differs from the ideal. Determine learners' perceived educational needs and preferences. Evaluate resources and barriers in the teaching environment (including those in Steps 2 and 4).

Use the needs analysis to develop goals and objectives that address the gap between current and ideal performance, taking into account available resources and learner perceptions. Objectives for online education tend naturally to focus on medical knowledge, but skills and attitudes can also be taught online. Well-stated objectives focus the design and function of the program, including evaluation. List the goals and objectives on the final website.

Clear objectives help define the role of online learning in your setting. Will it supplement an existing (traditional) course, or be the primary method of instruction? Most online teaching in medical education has supplemented existing courses, but many courses have been successfully taught completely online.

Estimate the class size. In Web-based teaching the classroom never fills up and handouts never run out, but this does not always mean that Web-based classes can expand *ad infinitum*. In an automated course—that does not require instructor intervention—an extra learner requires virtually no additional resources (a barely perceptible increase in network usage, and possibly a per-user fee on software or copyright licenses). However, in courses where the instructor plays an active role (moderating online discussion, for example) extra students will have a direct effect on faculty time.[13]

Step 2. Determine your technical resources and needs

Effective course design requires an understanding of both the subject and the instructional medium.[7] The technical details of Web design and programming can be delegated to a specialist, but a multidisciplinary approach—with at least one team member having in-depth understanding of Internet operations—is desirable.[9,14]

Meet early with an information technology specialist to discuss technical matters. At least one author recommends doing this even before setting goals and objectives.[10] You need to know the resources and limitations of your local network, including the number, type, and capacities of computers. Are there tools for multimedia development (digital camera, scanner, drawing and photo-editing software, equipment for recording and editing audio or video)?

Determine what e-learning management software (termed "courseware") is available at your institution. Content-free courseware provides tools (student registration, security, quizzes with automated grading and personalized feedback, online communication with instructors and other learners, tools to monitor learner participation, etc.) to assist the developer in implementing an e-learning website.[15] WebCT (WebCT Inc., Lynnfield, Mass) and Blackboard (Blackboard Inc., Washington, DC) are the most widely used courseware systems, but many others are available. Toohey and Watson review points to consider in selecting courseware.[16]

If you plan to employ a specialist or team to develop the site, find out whether they have developed an educational website before, and estimate development cost and timeline. Additional questions for those planning to develop the site themselves are listed in the Appendix.

Determine the technical resources and needs of your learners. Have they participated in an online course before? Are they comfortable using the Internet? If they will complete the curriculum from home, what computer system (Apple or PC) do they use, and what is the computer's capacity? What software do they use? Do they have high-speed Internet access? You will either need to accommodate the learners' resources or specify computer system requirements for the course.

Step 3. Evaluate commercial software and use it if it fully meets your needs

It is probably cheaper to buy commercial software on your topic than to develop it yourself. Critically assess how well it meets your needs before purchasing. First decide whether it aligns with your goals and objectives. A perfect match is unlikely, but is it close enough? Next determine whether the product will work on your network (consult your specialist). Most importantly, evaluate how well it capitalizes on Web resources (Step 5), promotes active learning (Step 6), and provides for evaluation (Step 8).

Even if existing software does not meet your needs, you may be able to purchase and implement part of the material you review (for example, an interactive anatomy atlas) as an element in your course. You may also get ideas on content or presentation that you can incorporate into your design.

Step 4. Secure commitment from all participants and identify and address potential barriers to implementation

Technical needs are important in an online course, but the human element is critical. Secure acceptance and commitment from all involved—administrators and faculty in addition to learners. In our experience, potential barriers include resistance to online learning, inadequate computer skills, insufficient time, or perception that the curriculum is a low priority. Identifying barriers early allows you to address them in a timely manner—before implementation begins. Greenhalgh[17] suggests targeting staff development to the needs of a given project, rewarding staff who participate in online initiatives with recognition or promotion, encouraging collaboration between content experts, educators, and technical specialists, and actively working to change organizational culture.

DEVELOPMENT

Step 5. Develop content in close coordination with website design

The key to effective e-learning is to develop content hand in hand with website design. It is common practice to copy lecture notes or the text of an existing curriculum onto a webpage. Such products—termed "shovelware"—are fast and easy to produce, but although they serve as repositories of information (lecture notes, syllabi, etc.) they are rarely effective for actual learning. Existing content can be used as the basis of an online curriculum, but will likely require significant modification. The most effective websites creatively integrate content with the power and flexibility of the Web to enhance learning rather than merely replicate traditional methods.[9]

Capitalize on the Unique Capabilities of the Web by Appropriately Using Multimedia, Hyperlinks, and Online Communication. The Web offers a wide variety of resources that, when appropriately used, stimulate and enhance learning, including multimedia, hyperlinks, and online communication. While these are powerful tools, it is important to keep in mind that they are just that—tools, used to create effective, efficient learning.

Multimedia refers to the simultaneous use of text, sound, video (with or without sound), slideshow (with or without narration), images, animation, and more. Text font, color, and size can be varied to highlight key points. Although multimedia does not necessarily improve learning, it improves satisfaction with the learning experience.[18–21]

Appropriate use of multimedia can enrich teaching but keep in mind the following four caveats.

First, it is easy to "overdo it." There is a fine line between making a page interesting and making it too "busy." Keep each element of the website focused on the educational objective. If it does not have a teaching purpose—remove it! Do not include multimedia just because it is available. Rather, choose the format (which may be just text) that will most effectively teach the principle. Changes in text format can enhance a page but they can also detract. Again, use restraint, focus on your objectives, and remember that multimedia *per se* does not improve learning.[22]

Second, multimedia is no substitute for good instructional design. As Rosenberg says, "Multimedia can add value, but simply adding multimedia to a bad learning program won't improve it."[23]

Third, keep in mind the issue of download speed. Learner satisfaction declines when downloads are slow,[24,25] suggesting that the advantages of multimedia are offset by slow speeds. This is less of a problem for users with high-speed access, but for users with a dial-up modem it becomes a significant issue. Large files—video, detailed graphics, animation, and even audio (if the connection is slow)—take longer to download. If a large multimedia object illustrates an important point it may be worth the inconvenience. Otherwise, reduce the file size (e.g., image resolution) or eliminate it altogether.

Fourth, pay attention to copyright law. "Fair use" laws that permit duplication for personal use do not, in general, allow reproduction on the Internet. This applies to both text and multimedia. Still, it may be cheaper to purchase a license to use high-quality material than to develop material in-house (but make sure the license extends to Web publication). See Hoffman's text[26] for a detailed discussion of U.S. copyright law as it pertains to the Internet, and consider consulting local experts.

Hyperlinks take the user from the current page to another site on the Internet. Target links might include a table on the same webpage, an illustration in the same website, an online clinical tool, or a journal article that discusses the topic in greater detail (see Fig. 1). Hyperlinks can also open documents (word processor document, spreadsheet, etc.) to view, print, or save for reference or modification. Appropriate links enrich a website and enhance function, but too many links may detract.

Online communication is dominated by e-mail, but also includes online discussion boards, chat rooms, and whiteboards (supported by many courseware systems), and Internet-mediated audio and video conferencing. Most online communication is *asynchronous*—with a delay from the time a message is sent to the time a response is returned. While at times such delays can be frustrating, asynchronous communication allows learners to communicate on their own schedule, and may actually increase learning by stimulating reflection and independent learning while composing a reply.[27–29] However, failure to address barriers (including uninteresting topics) may limit participation.[30] *Synchronous*
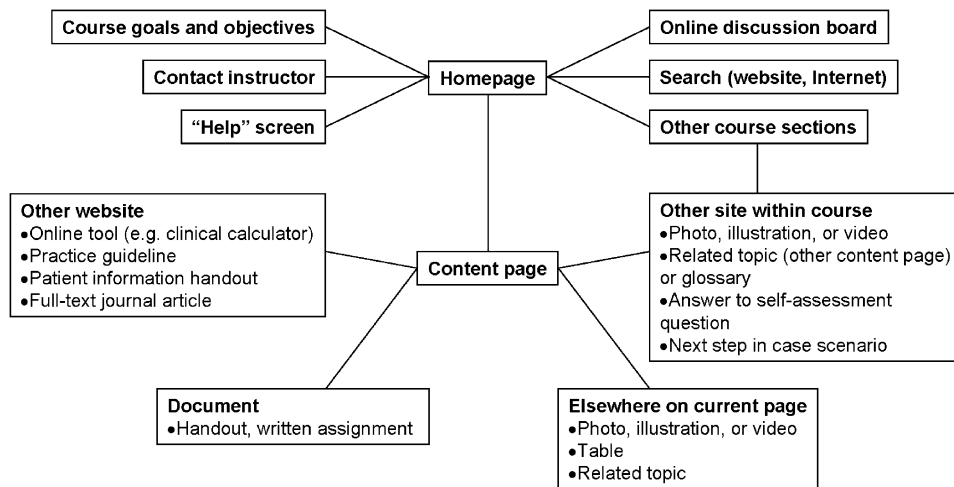
FIGURE 1. Some potential uses of hyperlinks in an educational website.

communication—ongoing "live" conversation—is very similar to face-to-face teaching. Collison et al. discuss effective strategies for online moderators.[27]

Adhere to Principles of Good Webpage Design. Educators teaching on the Web must understand and adhere to principles of good webpage design.[31] Poorly structured webpages are unattractive, inefficient, and confusing—all of which limit learning. Effective webpages are clear, concise, and consistent.[32] Table 2 describes additional characteristics of effectively designed webpages, and Figures 2 and 3 illustrate several of these principles. The National Cancer Institute maintains a webpage on evidence-based Web design and usability at http://usability.gov.[33]

Prepare a Timeline; Plan for Up-front Time Investment. Developing a quality educational website requires a large up-front investment of time. Once the site is complete maintenance will take less effort, and when spread over months or years the total investment (development time + ongoing teaching efforts) is cost effective. But if not anticipated, the initial time requirement may overwhelm developers and lead to a project's premature demise.

Prepare and follow a timeline.[31] Allow sufficient time to develop the content, create or find appropriate multimedia, develop active learning techniques, prepare evaluation instruments (write and validate questions), and pilot the site prior to full implementation. If you are forced to scale back the project remember that revisions to a website, including more complete implementations, are easily done down the road.

Step 6. Encourage active learning—self-assessment, reflection, self-directed learning, problem-based learning, learner interaction, and feedback

This must be done simultaneously with Step 5, but because of its importance we set it apart as a separate step.

Encouraging active learning is the most challenging, but often the most interesting and enjoyable, aspect of developing an educational website. Overcoming the inertia of passive learning requires a combination of creativity, careful planning, and content expertise. The degree of success in this area will in large part determine the effectiveness of the educational website.

The key to active learning is involvement of the learner in the learning process—encouraging them to apply new information.[34] Kaufman integrated several theories of education to outline seven "principles to guide teaching practice."[35] Table 3 describes how each of these principles can be satisfied by online methods. It is not necessary to employ all of these techniques in every online course. Rather, select techniques that best satisfy the requirements of the course content, environment, learners, and teachers. Figure 4 illustrates several active learning techniques.

Instruction and Feedback. Lectures have an important role in active online learning but, just as in face-to-face teaching, success depends on planning and presentation. Online "lecture" formats include written text, slideshow, and live or prerecorded video. Appropriate use of multimedia and hyperlinks can highlight important points, stimulate the imagination, clarify relationships between concepts, and promote in-depth study of topics of interest. Cases, self-assessment, and learner interaction can be part of the lecture plan.

Reading assignments are facilitated by online distribution (copyright issues may arise with this) or links to full-text sources. The same processes that would be employed in face-to-face teaching (study questions, group discussion, etc.) should be implemented in a Web-based program.

Other instructional methods include video (particularly useful for role modeling and skills training) and visual instruction (pathology slides, radiographs, photographs, etc.).[19]

Instructors can provide feedback with either asynchronous or live online communication. Automated,

Table 2. Characteristics of Effectively Designed Webpages

Clear and Consistent Page Organization
- Hierarchy of importance for items on the page, with more important things higher on page
- Logical groupings, with visual cues to help organize groups
- Headings and navigation labels reflecting a single theme (e.g., topic, function, or sequence)
- Consistent format from page to page

Wise Use of Space
- Division of page into grid of defined areas
- Alignment of all screen elements horizontally and vertically using grid
- Limited unused space (webpages require less white space than paper)
- Few distractions (e.g., unnecessary color, graphics, or animation)

Concise Text that Facilitates "Scanning"
(Web users "scan" rather than read from top to bottom and page design should optimize this.)
- Clear headings
- Short phrases and bulleted outlines
- Limited length of sentences (20 words) and paragraphs (5 sentences)
- Limited page length (single screen for homepage, scrolling limited to 3 screens for other pages)
- Topic summarized before presenting details

Clear and Consistent Navigation
- Site name/logo on every page with consistent position and appearance
- Navigation bar on every page with consistent position, appearance, and content including:
  - Link to homepage
  - Links to sections/categories
  - Search function
  - Utilities (help, additional information, contact information, etc.)
  - Navigation bar on right

Clear and Consistent Hyperlinks
- Clearly identified hyperlinks
- Descriptive and unambiguous hyperlink labels
- No use of graphics as hyperlinks
- Repetition of important hyperlinks elsewhere on the page (as needed)
- Minimum number of "clicks" to access a given point ("flat" site architecture)
- Consistent hyperlink format on all pages

Figures 2, 3, and 4 illustrate several of these characteristics. For additional information see references by Krug,[32] Horton,[10] and the National Cancer Institute.[33]

personalized feedback provided by the computer can also be effective,[36] and allows learners and teachers freedom in scheduling learning activities and alleviates demands on instructor time. Automated feedback can be delivered using hyperlinks (see Fig. 4) or courseware-supported quizzes. Regardless of which method(s) delivers feedback to the learner, it is important to provide a way for the learner to communicate directly with the instructor (e.g., by e-mail).

Application, Self-assessment, and Reflection. Self-assessment and reflection stimulate learning by reinforcing current knowledge or by highlighting differences between current

understanding and new information.[37] Because the learner sets the pace, online learning has great potential for encouraging these processes.

Online pretests and posttests, with correct answers and justification provided immediately, are one way to accomplish this. Questions can also be embedded within a lecture and linked to answers and explanations. Assigned short-answer questions and essays, often completed as a group project, are another way to facilitate self-assessment and reflection. Online links to potentially useful resources support each step of this process.

Patient cases and simulations encourage application of knowledge and development of judgment and clinical reasoning, in addition to self-assessment and reflection.[38] Simulations can evolve step by step, revealing one part of the scenario at a time and requiring the learner to make decisions (request additional information, order a test, etc.) or answer questions before proceeding.

Other methods to encourage reflection include learner interaction (see "Learner interaction" below) and online personal journals and portfolios.[39]

***Self-directed, Evidence-based, and Problem-based Learning.*** The self-directed learner asks and then seeks to answer his or her own questions. Questions develop at various points in the learning process—lecture and reading, self-assessment and reflection, interaction with other learners—and the Web is uniquely able to assist learners in answering questions as they arise. Online textbooks, search engines for both medical literature and the Internet, and full-text journal articles provide a wealth of information from which to derive evidence-based answers. However, students using Web-based resources must be selective in their searching to discriminate valid information from *mis*information and to deal with the immense volume of information available.

Relevant evidence should be presented and discussed.[31] Asking learners to interpret evidence reinforces learning.

Small-group problem-based learning encourages learners to define and address their own learning objectives based on a clinical scenario. This process has been successfully implemented on the Web.[6,40,41] Variations on this method would be effective for individual learners as well.

Perhaps the most effective learning occurs as learners confront a real clinical problem and must immediately learn and apply a solution ("just-in-time" learning[42]). We have found that after completing an online course learners will return to use the website while caring for patients.

Learner Interaction. Learner interaction serves a dual purpose as a social function and as a stimulus to active learning. Almost all courses should provide for "communities of learning,"[27] but whether to develop these online (see "Online communication" in Step 5), face to face, or both depends on the course design and resources. Courses where participants have limited face-to-face contact should
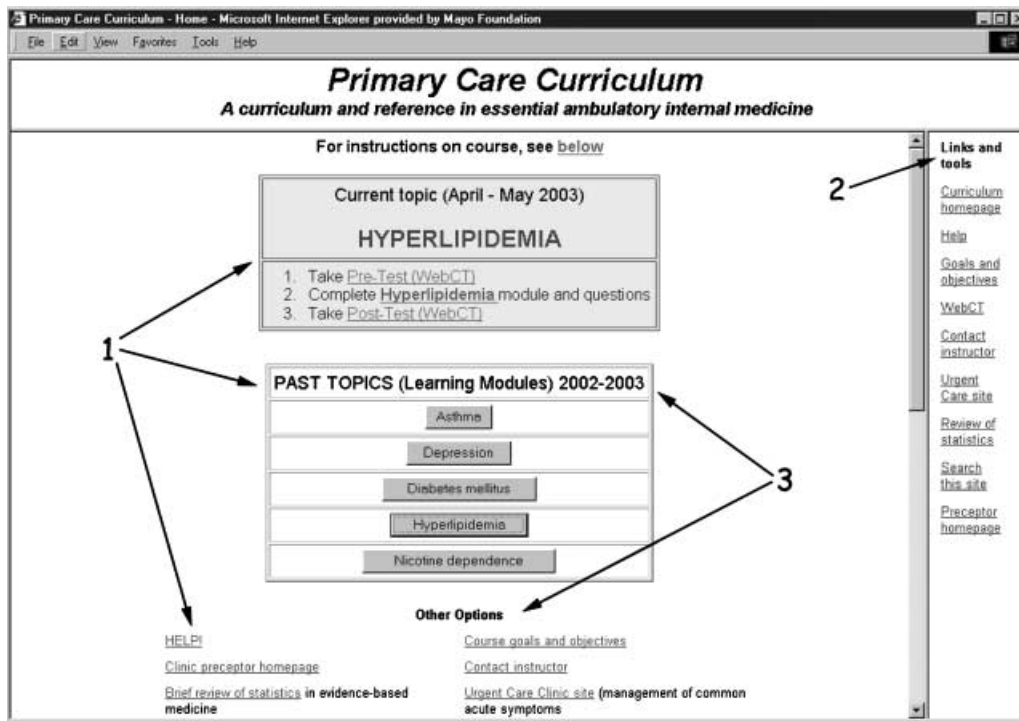
FIGURE 2. A well-designed educational website: the home page. This home page has several features of a well-designed Web page: 1) hierarchy of information, with the most important information at the top of the page, 2) navigation bar includes links to the home page, goals and objectives, help screen, WebCT courseware (with tools for assessment, course evaluation, and online communication), other sites within and external to course, and a means to contact the instructor, and 3) links to other sites within and outside course.

have more online interaction, whereas when learners regularly meet in person, online communication may be minimal or nonexistent. The amount of monitoring and interaction from the instructor varies with the topic being taught and with the goals and objectives of the course.

Step 7. Facilitate and plan to encourage use by the learner

We would like to think, "If we teach it they will come." Unfortunately, we know this is not true in traditional teaching, and multiple studies demonstrate that it is not true for online teaching either.[3,43,44] It is therefore important to plan ways to enhance learner participation.

*Make the Website Accessible and User-friendly.* How will users find your site? Providing the address on paper or in an e-mail may work the first time the learner accesses the site, but invariably the paper will be lost and the e-mail deleted. Better to place a link to the educational site on a frequently used homepage. Passwords also deter use. They may be required for security, but should be minimized as able. Webpages that are attractive, intuitive, and functional will encourage users to return. Those that are not deter further use.

Provide Time for Learning. It is tempting to develop an online course as an addition to existing coursework, or,

when replacing an older course with an online version, to divert the time dedicated to the previous course to other purposes. Such action would likely prove catastrophic for the online endeavor. Online learning permits flexible scheduling, but it does not eliminate the time required to complete the course. Independent and problem-based learning require "protected" time,[45] and so does online learning.

Motivate and Remind; Consider Rewards and/or Consequences. Motivated learners are essential to the success of any educational activity. Wlodkowski describes six keys to motivation: at the start of the activity, the teacher should encourage a positive attitude toward learning and identify and work to fulfill the needs that the learner hopes to meet during the course. During the learning process, the teacher should provide stimulation and promote a positive affective or emotional experience. Near the end of the activity, feedback should reinforce learning and highlight areas in which the learner is now competent.[46] Many if not all of these strategies can be creatively implemented online.

Demonstrating the website to learners improves participation.[47] We have found reminders, either in person or via e-mail, to be effective. Rewards for completion and/or consequences for failure to complete may be effective but are not possible for all learning activities. Teaching learners to regulate their own learning may also help.[22]
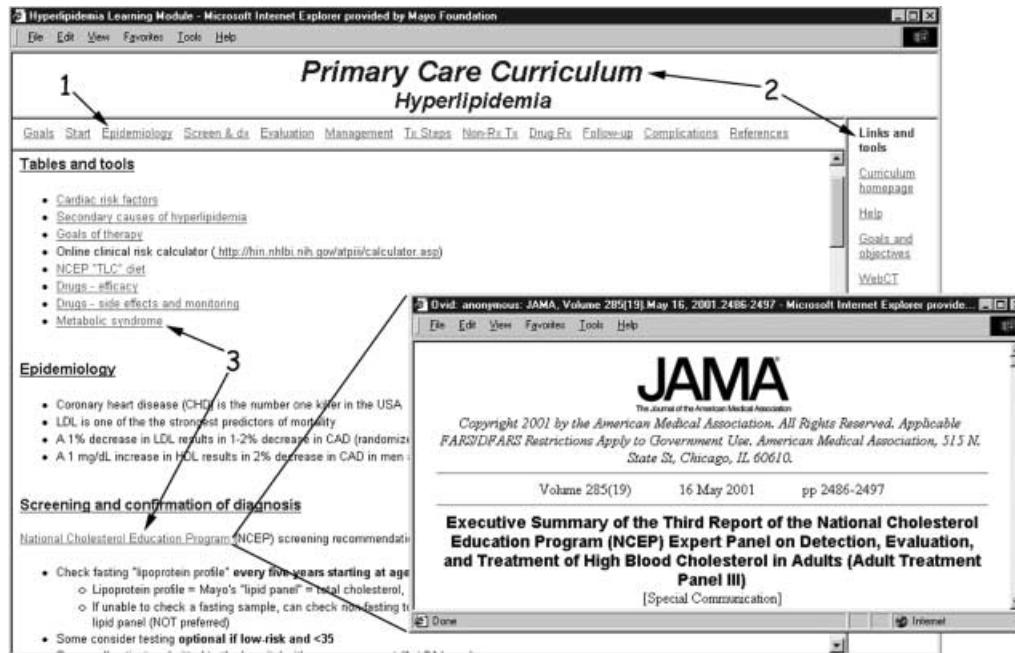
FIGURE 3. A well-designed educational website: a "content" page. Note the features of this content page: 1) navigation bar for sections within module, 2) consistent title bar and navigation bar on all pages, and 3) links to online clinical tools, full-text journal articles, and useful sites within course. Also note prominent headings, bulleted text (rather than paragraphs), and short sentences.

Table 3. Principles to Guide Teaching Practice and Corresponding Techniques for Web-based Teaching

Teaching Principle*	Web-based Teaching Technique
The learner should be an active contributor to the educational process	Learner interaction Problem-based learning Self-directed learning
Learning should closely relate to understanding and solving real life problems	Case-based learning Just-in-time learning
Learners' current knowledge and experience need to be taken into account	Learner interaction Problem-based learning
Learners should use self-direction in their learning	Self-directed learning
Learners should be given opportunities and support for practice, accompanied by self-assessment and constructive feedback from teachers and peers	Case-based learning Self-assessment Feedback
Learners should be given opportunities to reflect on their practice	Self-assessment Case-based learning Journals and portfolios Learner interaction
Medical educators should model good educational principles with their learners	Effective course and website design (using active learning principles) Instructor feedback

* *"Teaching principles" are modified from Kaufman,[35] used with permission from the BMJ Publishing Group.*

## Step 8. Evaluate—both learners and course

In contrast to many other teaching modalities, online education lends itself easily to assessment of both the learner[48] and the course itself. Courseware systems facilitate submission of assignments and administration of tests and surveys. Software can automatically grade these when answers are objectively defined. Plan both formative evaluation during the educational process and summative evaluation at the end of the course. Further discussion of evaluation is beyond the scope of this paper, but a brief review was recently published.[49]

IMPLEMENTATION AND MAINTENANCE

Step 9. Pilot the website before full implementation

Obtain input from several people, including targeted learners, at various stages in the design process. After development is complete, pilot the entire website prior to full
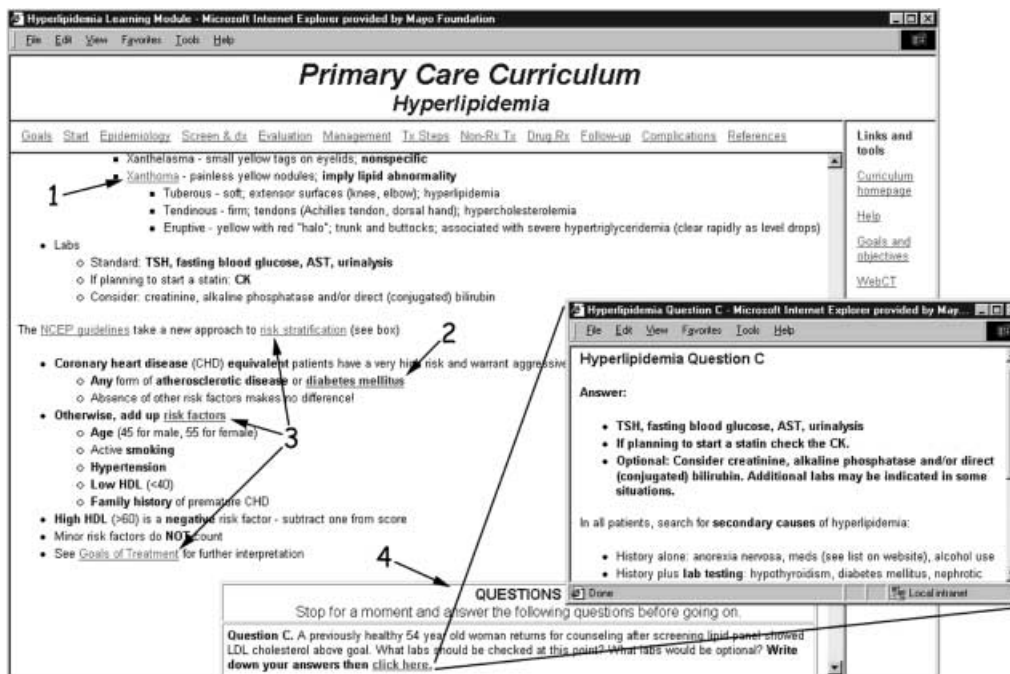
FIGURE 4. A well-designed educational website: promote active learning. Several features of this page promote active learning: 1) appropriate multimedia (photo not shown due to copyright restrictions), 2) link to other topic in course, 3) links to tables elsewhere in module, and 4) patient-based self-assessment question with answer.

implementation. The "gold standard" is formal testing in a usability lab. If this is not feasible, assemble a group similar to the targeted learners to test each component of the site informally. Collect information on navigation (especially navigation errors and points of confusion), how well objectives were met, time required, and overall satisfaction. Additional information about website testing is found in the references on Web design.[11,32,33]

Step 10. Plan to monitor online communication and maintain the site by resolving technical problems, periodically verifying hyperlinks, and regularly updating content

Budget time to monitor and moderate course activities. Ongoing faculty time requirements vary by course design, with courses involving faculty-moderated online activities demanding much more time than automated courses.

Although time requirements often decrease after completion of the development phase, maintenance will still be necessary. Plan for at least three ongoing activities:

First, plan to address the technical problems that inevitably arise. Many of these are best handled by a specialist.

Second, hyperlinks should be tested periodically. Links to pages within your website should continue to work, but external websites change frequently and links to those sites may unexpectedly fail.

Third, content should be updated regularly.[7] One advantage of the Web is the ease with which content—text, multimedia, hyperlinks—can be modified. Implement changes based on course evaluation as well as updated information. Consider scheduling periodic literature reviews.

CONCLUSION

We have presented ten practical steps to guide teachers in developing educational websites that implement principles of active learning.

Web-based learning accommodates shift schedules and distance learning, is easily expanded and modified, facilitates assessment, encourages self-directed learning, and is inherently learner centered.[50,51] Although it may not be superior to traditional methods,[2] these advantages warrant its use in many circumstances to supplement or even replace existing courses.

Harden[52] and others have suggested that teachers of the future may be as much designers of learning experiences as lecturers and tutors—true "facilitators of learning."[53] Designing Web-based learning involves more than simply putting together a colorful webpage. Effective online learning requires the teacher to carefully construct a program that integrates principles of active learning, motivation, and evaluation with creative Web design. Only as educators consistently implement these principles will Web-based medical education reach its full potential.

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APPENDIX

Additional Questions for Those Developing the Website Themselves

Technical details are beyond the scope of this paper. However, we list a few practical questions to be answered early in the process if you plan to develop the site yourself:

• Do you need authorization to develop and maintain a site?
• What resources are available to developers? What features and languages are supported by your network?
• How do you get the developed site on the Internet?
• Who do you contact to establish links to your site?
• Will you incur any charges?
• How will you implement site security?

Developing Effective Web-Based Learning: A Step-by-Step Review

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MAYO CLINIC

Purpose of Presentation

- This slideshow will illustrate the concepts we present in our article, "A Practical Guide to Developing Effective Web-Based Learning."

- We will take you step-by-step through the development process.

- Our topic will be a hypothetical Web-based module on cervical cancer screening for internal medicine residents. The "data" and events were invented for illustrative purposes.

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Presentation Format

- Each slide will pose a question based on the corresponding step in our article.

- Answers to the question will be found in a box such as this one.

•Sample answer

Steps 1-4: Preparation

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Step 1a. Perform a needs analysis

- What is the health care problem?

Cervical cancer screening:

- Cervical cancer is a common gynecologic cancer
- Screening has been shown to decrease morbidity associated with cervical cancer
- New technologies are changing the way screening is carried out

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Step 1a. Perform a needs analysis

- What should (could) be done to address this issue?

- We could educate
  - Residents and medical students
  - Staff
  - Patients
- We could implement institution-wide protocols

  We choose to focus on resident education

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Step 1a. Perform a needs analysis

- How does current performance differ from ideal?

  - (consider knowledge, skill, attitude, behavior)

- A survey of residents shows that:
  - Most are unfamiliar with liquid-based cytology and HPV testing in Pap screening (**knowledge**)
  - All agree that effective screening is important (**attitude**)
- A chart audit shows that only 2 residents are using these new technologies (**behavior**)
- Our current curriculum does not provide for training in liquid-based screening (**skill**)

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Step 1a. Perform a needs analysis

- What are the educational needs?

  - **Knowledge** - increase awareness and understanding of new technologies and recommendations
  - **Skill** - how to perform liquid-based Pap
  - **Attitude** - appears to be acceptable
  - **Behavior** - increase use of new technologies as appropriate

  This would be appropriate for the resident "continuity clinic"

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Step 1a. Perform a needs analysis

- What are the learners' educational preferences?

Resident surveys have shown that
- Most residents enjoyed Web-based learning in acute care clinic and continuity clinic
- Residents feel they have too little time for educational activities during continuity clinic
- Passwords decreased use of previous WebCT interventions

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Step 1a. Perform a needs analysis

- What resources do we have?

  - Plenty of computers (PC) in continuity clinic
  - Internet tools (WebCT available on the institution Intranet)
  - Faculty with expertise and interest in Web-based learning
  - Faculty with expertise and interest in Pap smears
  - Support of the residency program administration

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Step 1a. Perform a needs analysis

- What barriers do we foresee?

- **Resident attitudes**
  - Not all residents like using WebCT or Web-based learning
  - Residents did not like WebCT passwords
- **Faculty attitudes** - Individual faculty may not support Web-based learning
- **Funding** - for technical support
- **Time** set aside for learning

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Step 1a. Conclusion of needs analysis

We decide to develop a Web-based self-study module on Pap screening.

It will be done as an addition to clinical work in the continuity clinic.

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Step 1b. Specify goals and objectives

- What are the unit objectives?

  <u>We develop the following objectives</u>

  At the end of the Web-based module, the learner will be able to:

  - 1. Evaluate cervical cancer risk and outline an appropriate screening program for individual women.
  - 2. Contrast traditional and liquid based technologies for Pap screening, and discuss the role of HPV testing in Pap screening.
  - 3. Appropriately manage a Pap smear result of "Negative for intraepithelial lesion or malignancy."
  - 4. Appropriately manage a Pap smear with abnormal results, incorporating characteristics of individual patients.

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Step 1b. Specify goals and objectives

- How large will the class be, and how will this impact our resources?

- All 75 categorical residents will participate
- Tests will be scored by computer
- Faculty will review completion of tests, and the module will be graded complete / incomplete

- Since this is a self-study module and tests are scored automatically, the large class size will not cause an undue burden on faculty or other resources

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Step 2. Determine your technical needs and resources

- What are our technical needs and resources?

We need the following technical resources (those not yet met are in **bold**):

- Content expert
- Education expert
- **Programmer** ….
  - Plan: Contact Information Technology and schedule an appointment *before* starting on design
- Courseware – WebCT is available

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Step 2. Determine your technical resources and needs

- What are the technical needs of our learners?

- **Computer skills** – Most residents have participated in an online course before, and all are comfortable using the Internet
- **Equipment**
  - Residents will use clinic computers, so home computer setup need not be given great weight
  - Clinic PC's have Microsoft Internet Explorer 5.5 but do not have sound cards, so sound is not an option

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Step 3. Evaluate commercial software and use it if it fully meets your needs

- Is commercial software available to meet these learning needs and objectives?

- No available commercial software meets our learning objectives

  (Note that were commercial software available, it would likely save time and money.)

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Step 4. Secure commitment from all participants and identify and address potential barriers to implementation

- Who are the stakeholders? Do we have their support?

We will need support from the following stakeholders:

- **Administration** - we have their support
- **Faculty** preceptors
  - Experience shows that most will support Web-based learning
  - We will need to inform them about the process to so that they can encourage/motivate residents
- **Residents**
  - Our survey suggests that most will be supportive
  - We'll need to be aware of those who are not and work to resolve their concerns

Step 4. Secure commitment from all participants and identify and address potential barriers to implementation

- What barriers do we foresee, and how can they be addressed?

- **Computer skills**? - Not an issue for our residents
- **Time**? - We will ask administration to consider providing protected time
- **Attitude**? - The curriculum may be viewed as a "low priority"

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Steps 5-8:
Preparation

Step 5. Develop content in close coordination with website design

- Note:
  - This step and step 6 must be done together, in close harmony
  - Posting previously-developed content on the Web with little or no modification is *ineffective*
  - Existing content can form a basis for the course, but should be modified to incorporate principles of Web design

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Step 5. Develop content in close coordination with website design

- How will we capitalize on the unique aspects of Web? What **multimedia** would be relevant?

- We decide to include two "multimedia" components:
  - Photo of traditional and liquid-based Pap
  - Video clip illustrating specimen preparation for liquid-based Pap

- We conclude that other multimedia may actually distract from learning

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Step 5. Develop content in close coordination with website design

- How will we capitalize on the unique aspects of Web? What **hyperlinks** would be relevant?

• Hyperlinks will link to:
- •Other locations within the module (key words, tables, Help screen, etc)
- •Other Web-based learning modules
- •Full-text journal articles and practice guidelines
- •Patient handouts

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Step 5. Develop content in close coordination with website design

- How will we capitalize on the unique aspects of Web? What methods of **online communication** would be relevant?

  - Online communication is not necessary because all learners are working together in clinic

  - Residents will have e-mail contact to the course instructor

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Step 5. Develop content in close coordination with website design

- How will we design the Web page?

  - Principles of effective Web page design:
    - Clear headings
    - Consistent and clearly defined navigation
    - Bulleted text, short sentences
    - Avoid use of underlining (except for links)

  - More information can be found in the full article, and online at http://usability.gov

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Step 5. Develop content in close coordination with website design

- What will be our timeline?

- First steps (concurrent; total time **5 weeks**)
  - Content (**4 weeks**)
  - The post-test (**5 weeks**)
  - Multimedia (**1 week**)
- Develop the site itself (**6 weeks**)
- Pilot and revise site (**5 weeks**)
- Release

- Total: **16 weeks**

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Step 6. Encourage active learning

- **This is the most important step.**
  - Everything else is done to *support this step.*
  - It's easy to become infatuated with the **Web** design, but that should not happen at the expense of effective **learning**.
  - After all, **learning** is the goal.

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Step 6. Encourage active learning

- The key is to be *selective* in the choice of active learning methods.

- We will present different ways this module could be developed, but in reality we would only use a **select subset** of these ideas.

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Step 6. Encourage active learning

- How might we employ effective instruction and feedback?

  - Online lectures
    - Text - prepared by content expert
    - Application questions (see below) embedded in lecture
  - Reading assignments – e.g. national guidelines and other source material
    - With a series of questions and/or cases
  - Video clips (i.e. illustrating specimen preparation)
  - Automated, personalized feedback

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Step 6. Encourage active learning

- How might we encourage application, self-assessment, and reflection?

  - A Web-based pre-test (activation of knowledge)
  - Embedded self-assessment questions with personalized feedback
  - Case-based problems and feedback
  - Online discussion (discussion board) as a group e.g. case problem, series of questions, reading assignment
  - Patient simulations
  - Application of knowledge to real patient

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Step 6. Encourage active learning

- How might we support self-directed, evidence-based, and problem-based learning?

•Evidence-based lectures
•Links to full-text journal articles
  •With questions to guide interpretation/understanding
•Problem-based learning (e.g. group work via discussion board)

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Step 6. Encourage active learning

- How might we support learner interaction (learning community)?

- The learning community is a necessary component of **any** learning experience

- However, in this case we decide it is not necessary to implement this online (as previously discussed)

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Step 7. Facilitate and plan to encourage use by the learner

- How will we make the website accessible to the residents?

• Place links to the course Website on the residency homepage and the continuity clinic homepage

• Periodically e-mail residents the link

• Integrate the WebCT log-on system and the institutional Intranet log-on system (so that a separate password is not required)

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Step 7. Facilitate and plan to encourage use by the learner

- How will we make the website user-friendly?

  - Adhere to <u>guidelines</u> for attractive and usable websites
  - Avoid passwords (except to access WebCT, as above)

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Step 7. Facilitate and plan to encourage use by the learner

- How will we provide time for learning?

  - Residency administration agrees to block off time from clinic to complete this (and future) modules.

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Step 7. Facilitate and plan to encourage use by the learner

- How will we motivate residents and remind them to complete the course?

  - **Pre-test** (highlight learning needs)
  - **Case-based problems** (emphasize relevance of what they are learning)
  - **Self-assessment and feedback** (provide a positive affective experience)
  - **Post-test** with answers and individualized feedback (reinforce learning)
  - **Periodic e-mail reminders**

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Step 8. Evaluate - both learners and course

- How will we assess learners?

- Self-assessment questions with feedback (formative assessment) during course
- Post-test with feedback (formative and summative assessment; via WebCT)
- Chart audit in six months to see if behavior changes

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Step 8. Evaluate - both learners and course

- How will we evaluate the course?

- **Development** - Time required, resources used
- **Use** – Rate of completion and ongoing use
- **Objectives** –
  - **Effect on achievement** - Learner test scores (WebCT)
  - **Effect on behavior** - Chart audit in six months
- **Student perceptions and suggestions** – Post-module survey (WebCT)

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Steps 5-8:
Implementation and Maintenance

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Step 9. Pilot the website before full implementation

- How will we test and pilot the website?

First pilot – Informal presentation of screen "mock up" to get feedback from colleagues

Second pilot – "Usability testing" with several residents after the site is fully developed
- Ask each resident to access and complete module, "thinking out loud" while they go
- Observe silently, taking note of "errors" (resident clicks in the "wrong" place), steps that were confusing or took longer than expected, and the total time
- Videotape the episode for later review

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10. Plan to monitor and maintain site

- Are there course activities that will require us to monitor/moderate?

  - This course will require minimal monitoring except for periodic reviews to verify course completion.

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10. Plan to monitor and maintain site

- How will we maintain the course?

  - Monitor and correct **technical problems**
  - Test all **hyperlinks** on a bi-monthly basis
  - Re-assess literature in one year and **revise site** if needed (or sooner, if significant changes to guidelines occur)

Summary

- We have planned for an effective website, starting with a needs analysis and proceeding up through plans for evaluation and maintenance.

- We have selected instructional designs that promote active learning while capitalizing on the unique advantages of the Web.

- Our website will be an effective tool to facilitate learning among our internal medicine residents.

- **You can do this, too!**

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