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Guidelines for Effective Online Instruction Using Multimedia Screencasts

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Gaining opportunities for in-person instructional contact with students is a common challenge for librarians (Arant-Kaspar and Benefiel, 2008). Often, hard-won class time with students is too short to address the students' gaps in research knowledge, and difficult choices about priorities need to be made. If instruction programs are successful, demand for in-person sessions can overwhelm staff resources, and traditional models of in-person library instruction often reach only a minority of students. In addition, web-based teaching and course delivery tools have become commonplace in universities and colleges over the past few years. In this environment, online instruction has many potential benefits for academic libraries. Online instruction can help support web-based courses, supplement in-person instruction sessions, reach more students, convince faculty to use library instruction even if they can't give class time for in-person sessions, and help stretch limited staff resources.

Online instruction also suits many of our students, who spend increasing amounts of time online. These students are used to multimedia environments and to figuring things out online for themselves (Lippincott, 2005). They tend to value the convenience provided by technology, and expect to be engaged by their environments (Oblinger, 2008). For these students traditional in-person classroom instruction sessions, which tend not to be connected to their time and place of need, may not be as effective any more (Ladner *et al*., 2004).

Academic libraries have used online instruction for many years, but until recently there were limited options. Libraries have tended mainly to produce tutorials using a series of web pages, sometimes with

interactive features. Students tend to be more at home with images than text, rely heavily on graphics to interpret web pages, and often learn best by doing (Lippincott, 2005; Oblinger, 2008). Therefore, many libraries have invested in producing Flash tutorials to add multimedia, improved graphics, and interactivity to their online instruction. However, creating Flash applications traditionally requires specialized knowledge and skill, and has a steep learning curve for beginners.

Recently, new tools have made creating Flash multimedia much easier. In particular, screencast software programs have become readily available. These programs record actions on your computer screen and produce multimedia Flash videos. They are either relatively cheap or free, fairly easy to learn even for beginners, and require little technical knowledge, putting online multimedia creation within the reach of most instruction librarians. Using these new screencast tools, more libraries have begun creating online tutorials and database demos to use in online instruction.

Only a few articles have been written about screencasts, or streaming multimedia tutorials, in the library literature. Existing articles give an introduction and overview to the topic, describing screencasting, available software, and its uses (Notess, 2005), or outlining the process of using screencast software and comparing features of various software packages (Long and Culshaw, 2005). A few articles discuss the use of screencasts in library instruction. Peterson gives a case study of the use of screencasts in a class to teach the Dewey Decimal System, but doesn't give the results of the pilot project or discuss its effectiveness (2007). Tempelman-Kluit outlines several factors for the effectiveness of online tutorials based on cognitive learning theories, then compares a streaming multimedia tutorial with a static web tutorial. She finds that the streaming media version has more of the factors needed for successful learning, and is therefore presumably more effective (2006). Zhang provides a useful overview of factors in effective web tutorial interface design, including text, color, and navigation, that applies equally to screencasts (2006).

Despite Tempelman-Kluit's findings that streaming media tutorials like screencasts have the potential to

be more effective than static web tutorials, the use of the tool itself doesn't guarantee success. Research on online instruction has consistently found that there is no relation between the technology or tool used and success at teaching or learning (Rice *et al.,* 2005). If this is the case, how do academic librarians ensure that they use new technologies like screencasting effectively, so they help students learn? This article examines research in cognitive psychology and education on the effective uses of multimedia in learning in order to come up with guidelines for using streaming multimedia tutorials effectively in academic library instruction.

Research on Effective Multimedia

Cognitive psychologists have done a large amount of research on the effective use of multimedia in learning. Much of this research looks into how people process information effectively, and is based on cognitive load theory. According to cognitive load theory, our short-term or working memory has a limited capacity and can only handle so much information effectively at one time (Nguyen and Clark, 2005). Implications for instruction include the need to be aware of the limits of student capacities for information processing. When we give students more information than they can process at a given time, their working memory is overloaded and they can't process anything well, which leads to poor understanding, retention and learning (Nguyen and Clark, 2005).

Is multimedia Needed?

Multimedia, screencasts, and other types of animated media put high demands on short-term memory, since a lot of information (text, graphics, audio, motion) needs to be processed simultaneously (Betrancourt, 2005). This means that it can be difficult for people to process information effectively from multimedia. Studies have shown that instruction using static graphics and visuals, like labeled screenshots, can be as effective or more effective for learning since it places fewer demands on our short-term memory (Clark and Lyons, 2004), leading to better understanding and retention.

Since multimedia is inherently more difficult for learners to process, it should only be used as an instructional tool when it is helpful for learning. The first and most important question to ask when designing screencasts or streaming video tutorials is whether the multimedia is needed at all, or whether the instruction could be done as effectively in some other way. Multimedia is potentially useful in many situations, such as showing processes in action or adding opportunities for student interaction with the material in a realistic setting (Betrancourt, 2005). If it isn't necessary, however, avoid doing a multimedia tutorial or screencast.

Minimize Memory Load

If you do decide to use screencasts, it is important to take steps to minimize the burden multimedia places on working memory or students will not learn as effectively. To minimize memory load in multimedia instruction, it is useful to understand what creates it. There are three kinds of cognitive load to be aware of: intrinsic (related to the instructional content), germane (related to the activities that the students do), and extraneous (everything else) (Nguyen and Clark, 2005). The load on working memory needs to be minimized in each of these areas so people can process information more effectively and learn better. Fortunately, a significant body of research exists in this area, with several helpful principles and recommendations on minimizing cognitive load.

Minimizing Content-Related Load

To minimize content-related load on student memory, simplify the content of screencast or multimedia tutorial as much as possible. This doesn't mean dumbing down content. Instead, focus on what the main points are, then organize and present these to make it as easy as possible for people to understand them clearly. Don't include information that isn't needed to convey the main points, even if it seems interesting or useful.

One way to streamline the content of a screencast effectively is to create clear goals for it: what do you hope to teach? In successful instruction, the content, practice activities and assessments are all aligned with the instructional goals (Carliner, 2002). Setting instructional goals as a starting point will help you decide what is essential to include and what is not, will give the tutorial a strong focus, and will help prevent content-related memory overload.

Cognitive psychologists have come up with other ideas and principles for reducing content-related memory load, based on research in how people process information. Many of these ideas relate to how content is presented. The basic principle is to make the content as easy as possible for learners to remember by presenting it in ways that are easy to process and understand. Kosslyn outlines a series of principles for effective PowerPoint presentations, which apply equally to screencasts and online multimedia (2007). He recommends:

- Giving an outline of what will happen right at the beginning, to prepare students for what they will encounter
- Clearly indicating when each part is beginning and ending
- Explicitly and clearly stating each point
- Ending with a summary to help reinforce concepts in student memory

Another recommendation for minimizing memory load is to use words with graphics. Richard Meyer's research in multimedia has found that using words along with graphics produces more effective learning than using either one alone (2006). The words and graphics are processed simultaneously but use different parts of working memory, and the effect is that each reinforces the other. However, words and graphics should be located near each other so it is clear that they are connected. Otherwise, it is more difficult for learners to process them together, increasing memory load (Mayer, 2006).

Splitting longer or more complex content into small segments and arranging content in logical sequences

also help reduce content-related memory load in multimedia tutorials. Studies have shown that making short segments instead of longer videos or tutorials helps students learn better and reduces the effort it takes for them to process information (Lusk *et al*., 2008; Nguyen and Clark, 2005). Each chunk or segment should focus on one major objective or section of the content. This helps learners process information more easily, since they only need to concentrate on one point at a time. Arranging instructional content in logical sequences also helps learners process information better. Start with easier and progress to more difficult material, and similarly start with simpler and progress to more complex concepts or content.

Minimizing Activity-Related Load

Activities required by the student during the screencast or streaming multimedia tutorial can also hinder learning by contributing to working memory overload. To minimize activity-related memory load, make sure that all activities are within the capabilities of the students. There should be no technical difficulties to overcome. The technologies used should make everything, from clicking to start a screencast to interactive quizzes, easy to understand and to do. The interface and navigation should be clear and simple. Any examples and activities used in a screencast or multimedia tutorial should be easy for the students to understand and complete without assistance.

Similarly, make sure that the screencast's content and activities are appropriate for the students' level of knowledge. For example, one effective way to present information to beginners is through worked examples, which present a problem and then show the steps required to solve it (Renkl, 2005). However, students often have difficulty processing the steps and creating explanations on their own, and need help understanding the concepts involved in solving the problem or example, and how the processes involved work (Renkl and Atkinson, 2002). Otherwise, the content will put a larger strain on their working memory and they will learn less.

Minimizing Extraneous Load

Minimizing extraneous memory load is especially critical for a successful screencast or streaming multimedia tutorial. Extraneous load is created by elements of the screencast that don't contribute to the content or activities, and which therefore aren't important to learning success. This is the kind of memory load which should be easiest to reduce. When reduced, it is less likely that students' attention will be distracted from the content, and more likely that they will understand and learn successfully.

Reducing extraneous load involves simplifying and removing as much as possible that isn't absolutely necessary to the content or activities. All unnecessary graphics, text and audio should be removed, since graphics and words that don't directly contribute to the main points distract the learner's attention away from the main instructional messages (Mayer, 2006). In particular, watch out for and remove any graphics or visuals that are merely decorative, or generate associations that are interesting but not related to the main point (Clark and Lyons, 2004). Make remaining graphics as simple as possible. Also make them consistent in style and format throughout the screencast, to reduce the effort needed to interpret them (Clark and Lyons, 2004). Although it is important to use words and graphics together, words should always be present only in one format. Having similar words in two formats, such as text and audio together, creates extra memory load and actually decreases learning (Mayer, 2006).

Directing students' attention to the most important points also reduces extraneous memory load and improves learning. To direct attention, show processes and tasks in context. For example, show a database search screen so the students know where the search box is located, rather than showing them only the search box out of context. If students don't have context, they may not learn enough to apply what they are learning (Clark and Lyons, 2004). However, the most important part of the larger screen needs to be highlighted with visual or verbal cues so students know where to direct their

attention. Visual cues might include using an arrow, circle, or grayed-out background to show the important area on the screen, or inserting a title screen between sections to indicate a change in topic. Verbal cues include putting captions on the screen, repeating or summarizing points, using tone and emphasis to indicate important points, or saying explicitly that a particular point is important.

Research on Effective Online Instruction

Research in cognitive psychology gives us important guidelines for creating clear, focused multimedia tutorials that are easy to understand and remember. These attributes are important, but they are not the only factors that contribute to effective multimedia instruction. In the fields of education and librarianship, little research has been done specifically on streaming multimedia; however, much of the research on best practices in online instruction also applies to multimedia tutorials and screencasts. The following sections discuss some of these best practices and how they can be implemented in screencasts and multimedia tutorials.

Include Interactivity

Learning is an active, interactive process where learners make meaning from new experiences. According to Kolb's theory of how the learning process works, real learning can't happen without participation in actual experience (MacKeracher, 2004). Therefore, providing students with some concrete, interactive activities to help them practice is important for meaningful learning. The ACRL Characteristics of Programs of Information Literacy that Illustrate Best Practices (2003) and library researchers outlining best practices in online library instruction all recommend active learning or interactivity (Dewald, 1999; Reece, 2007; Tempelman-Kluit, 2006). Several studies have also shown that students expect and prefer interactivity, especially in multimedia learning (Armstrong and Georgas, 2006; Markey *et al*., 2005; Sims, 2003).

What does interactivity mean, though, especially in the context of streaming multimedia tutorials and screencasts? Effective interactivity involves more than simple clicking on buttons or links. Learners expect interactivity to include control and active engagement in activities (Sims, 2003), and feedback on progress also plays an important role (Reece, 2007).

Control

Control is a major component of interactivity. There are three options for learner control over multimedia: control over content, help, and pace (Clark and Mayer, 2003). Control over the sequencing of content involves letting students have some choice over what path to take and what they do next. Control over access to help or learning support involves the ability to click on links for additional explanations or "bonus" material for remedial help, or to find information about how to ask questions.

Control over the pace of the multimedia or screencast is also important. Researchers have found that multimedia instruction is more effective when the learner has control over the pace, and also that learners prefer to have control over the pace of multimedia tutorials (Betrancourt, 2005; Mayer, 2006; Veronikas and Maushak, 2005). Therefore, at a minimum multimedia tutorials or screencasts should allow learners to control the pace. This can easily be done by including Flash controls that allow pausing, reviewing, fast forwarding, stopping and starting.

Engagement

Engagement is another major component of interactivity, and consists of practice activities and active learner participation. Learning transfer, or the ability of learners to apply what they have learned to actual situations, is a basic goal of teaching and learning (Commission on Behavioral and Social Sciences, 1999). Learning enough to apply new knowledge usually requires active engagement or

practice in a realistic context (Halpern and Hakel, 2003; Nguyen and Clark, 2005). Ideally, therefore, multimedia screencasts should include interactive activities that help students practice the skills and concepts being taught.

Good activities should be meaningful to the learner and simulate a real context. Clark, Feldon and Choi suggest a number of characteristics of successful learning activities for online learning. They recommend that activities be concrete and authentic (2006), or in other words provide realistic tasks in a realistic situation that is recognizable and relevant to the student. This advice corresponds with a basic principle of adult education: successful instruction needs to have clear relevance to the learners (Dunlap *et al.*, 2007). People are more motivated to learn when instruction is seen as relevant, and motivation increases learning success (Stolovitch and Keeps, 2002). Therefore, it is important to make screencasts and multimedia tutorials relevant to students. To do this, use examples or databases that students will actually encounter, and help them complete tasks and solve problems that they will need to solve. This creates a realistic and meaningful context for students and helps them see the relevance of what they are learning.

Screencasts and multimedia tutorials can easily and effectively simulate a real context for learners, making it easy for example to create a database search demo that shows an actual search. Creating interactive activities can be challenging, however, since most screencast software has limited capabilities for providing interactivity. Most commercial programs, like Adobe's Captivate and TechSmith's Camtasia, can create some kinds of interactivity, like clicking on the screen and making something happen, entering text for a search, or inserting quiz questions. However, interactive activities don't have to involve software features. For example, interactivity could be introduced by suggesting practice exercises at the end of a tutorial for students to try on their own, or by posing questions part way through the tutorial for students to think about. Adding interactivity in a screencast or streaming video tutorial can be a challenge, so think creatively about ways to engage learners in this format for effective learning.

Feedback

Feedback is an important aspect of interactivity and student engagement (Reece, 2007). Since many of our students are used to web and e-learning situations where they get immediate feedback from their actions, they often expect feedback (Carliner, 2002). In addition, when they are new to a topic, learners need feedback to let them know how they are doing. Unless practice activities are accompanied by feedback students will not know if they are understanding properly, and may not be able to apply what they learned effectively (Halpern and Hakel, 2003). This kind of feedback helps to build confidence in learners and to increase their motivation (Stolovitch and Keeps, 2002).

Feedback can be built into screencasts or streaming media tutorials in a number of ways. For example, learners can see the consequences of their actions if search results are displayed after they type in a simulated search. Scenarios can allow learners to choose what to do, then show them what happens when they choose each action. Or, quiz questions can be included to check understanding and display feedback immediately. Ideally, feedback should include explanations that show students why an answer or choice is right or wrong so they can improve their understanding of the concepts involved.

Promote Critical Thinking

The goal for most instruction is to help the learner think critically so he or she can adapt their learning to new situations. Teaching successfully with critical thinking in mind involves linking concrete skills and actions to a more conceptual framework. This connection between concrete actions and abstract principles creates better learning and retention, and helps students to apply what they learn in real life situations more effectively (Commission on Behavioral and Social Sciences, 1999).

Therefore, teaching for critical thinking involves students in more than just a series of steps and practice activities. Students need to see steps put into a broader framework, and think about how the steps relate

to a larger process so they understand why each step is important. This can be done easily at a basic level by, for example, outlining the steps in the search process at the beginning of a screencast, and then clearly identifying each step as it is demonstrated. Links to a conceptual framework can be created at a higher level by creating scenarios that place tasks in a wider context, for example by showing how to solve a commonly encountered problem. Strategies that allow students to think critically about tasks also include providing them with multiple, slightly different examples or comparing good and bad examples. These strategies encourage students to evaluate the examples more closely and to apply what they learn to slightly different situations more effectively.

Bloom's taxonomy provides another way to think about how instruction integrates critical thinking. The revised version of Bloom's taxonomy presents different kinds of learning goals, organized on a continuum from simple and concrete to complex and abstract (Krathwohl, 2002):

1. remembering
2. understanding
3. applying
4. analyzing
5. evaluating
6. creating

Bloom's taxonomy is more useful for evaluating an entire series or program of tutorials, since it would be hard to include all six categories of learning in a two minute screencast. However, it is useful to remember that the different categories exist, to choose consciously which you are aiming for, and to design the tutorial accordingly. To promote critical thinking, it is also useful to concentrate on the more abstract and conceptual levels of learning (analyzing, evaluating, creating) in some screencast tutorials, rather than using only the lower three levels (remembering, understanding, applying).

Education researchers Dunlap, Soebel and Sands have developed a list of strategies that can help achieve different levels of Bloom's revised taxonomy (2007). To achieve the lower three levels of

learning (remembering, understanding, applying), they recommend creating interactive activities for students that demonstrate concepts, provide opportunities to practice skills, or involve students in organizing or mapping what they know through concept or mind maps. To achieve the higher levels (analyzing, evaluating, creating), they recommend encouraging students to follow their own paths through the content, to access extra "enrichment" content, and to create interactive activities for students that help them assess and evaluate solutions, connect ideas, and create their own solutions to problems.

When planning a screencast or multimedia instruction project choose activities and interactions based on the desired type of student learning, and try to integrate the steps and activities into a broader conceptual framework for students. Encouraging critical thinking in this way can be challenging given screencast and multimedia software limitations, but if you know what you want to accomplish solutions can often be found by using the software creatively.

Know your Students

In online instruction, there is less opportunity to interact with students, and you can't make immediate corrections when things aren't going well. Students can hit the back button or escape the screencast quickly and easily, so the instruction needs to be targeted specifically to their needs and existing skills. Therefore, it is important to learn about the students in advance and use this knowledge to plan the instruction.

The first phase in most instructional design models involves analyzing the learners. Questions should include: who are the learners I am targeting? What are their demographic characteristics? What related skills and knowledge do they already have, and what gaps are there? How familiar are they with technology, and what access to technology do they have? What is their motivation? How interested are they in the content? What influences affect them and their learning? (Carliner, 2002). After compiling and analyzing this data, create the tutorial to match the characteristics, skills and needs of the students.

In particular, pay attention to how much the students already know and create instruction that builds on their existing knowledge. Since people understand and remember more easily if they can connect new information with something familiar to them, building connections with what learners already know is a key strategy for effective learning. When teaching first year students how to search a database, for example, use comparisons or analogies to other search tools that students already know, like Google or iTunes.

It is also important to know the students' level of pre-existing knowledge because different strategies are required for learners with different levels of expertise. One size does not fit all when it comes to multimedia tutorials. Multimedia learning strategies that work well for learners with low existing knowledge may actually hinder learning for those with more pre-existing knowledge (Kalyuga, 2005).

Beginners learn more effectively when provided with structure and guidance, fairly detailed explanations, and opportunities to practice (Nguyen and Clark, 2005). For novice students, provide an outline of the content at the beginning of the tutorial or screencast (Clark and Lyons, 2004). The outline helps students create a conceptual framework for their learning, and lets them know what to expect so they can absorb information better as they progress. To help with understanding, introduce basic concepts at the beginning of a tutorial, using the same words and images used in the rest of the tutorial (Mayer, 2006).

Presenting information through worked examples also helps beginning learners. Worked examples involve giving an example of the problem or process to be learned, then showing how to work through it highlighting the different steps required (Renkl and Atkinson, 2002). Since novice learners are not always good at creating their own explanations for why or how processes work, make sure the examples help learners make connections with the underlying concepts and principles rather than focusing just on the mechanics (Renkl, 2005). As discussed earlier, this connection between the concrete and the abstract also helps students with critical thinking. One strategy would be first giving an overview of a

search process, then giving a demonstration of how a search works step by step, then giving a summary of what happened and why. Another strategy would be to give more than one example of a search, each with slightly different contexts (e.g. two different databases), so students can see the principles that different searches have in common. Using multiple examples helps students create a better conceptual model of how the search process works, and therefore helps them better apply what they learned to different situations (Commission on Behavioral and Social Sciences, 1999).

For more advanced learners, some of these strategies are counterproductive. Detailed explanations and instructions may confuse or frustrate people who already know something about the subject. Therefore, for more advanced learners it is important to keep explanations and instructions simple and to a minimum (Kalyuga, 2005). Studies also recommend eliminating as much redundancy as possible for more advanced learners; for example, it is usually better to use only graphics or only words to explain something, rather than both together as for novice learners (Nguyen and Clark, 2005). In addition, more advanced students learn better when they are provided with less structure and more control, such as the ability to skip sections, or to choose their own non-linear path through the tutorial content (Clark and Mayer, 2003; Nguyen and Clark, 2005). Therefore, for more knowledgeable learners provide less structure in the tutorial; for example, give questions and problems for them to solve on their own at the end instead of worked examples throughout. To allow flexibility in navigating through the content, possibilities include providing a table of contents that allows students to choose which sections they wish to view, or breaking up a longer tutorial into small, focused sections and creating a series instead.

Since it is difficult to create a single tutorial that works for all learners, ideally create different versions of a tutorial would be available for different kinds of learners. If that is not possible, consider having pretest questions that could analyze students' knowledge and recommend which sections they should take, or having links to "remedial" sections that beginning learners can follow but advanced learners don't have to. Allowing control over pacing, ability to skip some content, and control over features such as audio or text display is particularly important in screencasts for learners with different levels of knowledge.

Summary and Conclusions

The technologies that have made streaming video and screencast tutorials easy to create are still new, as is their use in libraries. Most existing library screencasts are demos that show database searches and include little interactivity. However, there are many possibilities for their use in more advanced ways as part of a program of online instruction.

This article has made recommendations for using multimedia screencasts and tutorials effectively for instruction, based on research in cognitive psychology and education. Cognitive psychology helps us understand how to make our screencast tutorials easy to understand and remember by minimizing their burden on our short-term memory processing. Helpful strategies include simplifying and focusing content around clear goals, presenting content so it is easy to understand the main points, making sure the interface, technology, and practice activities are easy to understand and complete, removing any words or graphics not absolutely needed, and directing attention to the most important points using visual and verbal cues. From research in education and librarianship, we can learn from recommended best practices in online instruction. Recommended strategies include providing interactive practice activities, allowing students to have control over the pace of a screencast, including feedback to students, encouraging critical thinking by putting concrete actions and steps into a broader conceptual framework, and designing screencast tutorials around what students already know. These recommendations are summarized in the form of a checklist.

The use of streaming video and screencast tutorials is still relatively limited, and it would be useful for librarians to have more examples in practice and more research in many areas. Assessment is one major direction that requires future study: how effective are screencasts at promoting desired learning outcomes compared to other types of online instruction, what features contribute or detract from successful learning, and when is streaming video is more effective or useful than other types of

instruction. It would also be useful to see more research and examples of screencast or multimedia tutorials that used branching and student control over the content and navigation, as well as on effective use of interaction and practice activities.

In addition, many research studies in cognitive psychology and education assume that online instruction will take place in the larger context of a semester-long course. It would be helpful to see how recommendations based on this context work out in practice using short tutorials on the library's web site, which are often optional and outside of a mandatory course context. Screencasts and multimedia tutorials are a relatively new way of offering instruction in libraries, and we are still beginning to see how they can be used effectively in our instructional context.

Checklist: Guidelines for Effective Multimedia Screencasts

Need for Multimedia

- ☐ Is multimedia needed or would static graphics with text work as well?

Minimize Cognitive Load

- Content:
  - ☐ Create clear goals
  - ☐ Focus content on main points only
  - ☐ Give outline at beginning
  - ☐ Explicitly state each point
  - ☐ Indicate when you are beginning/ending each part
  - ☐ End with a summary
  - ☐ Split content into small segments/chunks
  - ☐ Sequence content logically: start with simple, work up to more complex
  - ☐ Use words (text or audio, not both) with graphics
  - ☐ Put corresponding words and graphics near each other
- Activities:
  - ☐ Make activities within capabilities of students
  - ☐ Make sure technology works well
  - ☐ Provide clear interface, navigation and instructions
  - ☐ Make activities easy to complete without help or explanation
  - ☐ Use worked examples for novices
- Other:
  - ☐ Remove unnecessary graphics, text, and audio
  - ☐ Don't use purely decorative or unrelated graphics
  - ☐ Make graphics as simple as possible
  - ☐ Use consistent graphics, style throughout
  - ☐ Show graphics in context (e.g. whole search screen, not just search box)
  - ☐ Focus attention on important areas with visual or verbal cues

Include Interactivity

- ☐ Give learners control over pace
- ☐ Give learners help they can access on demand (e.g. glossary, links to further explanations)
- ☐ Include interactions or activities that simulate a realistic context
- ☐ Include feedback on activities

Promote critical thinking

- ☐ Link steps to a broader conceptual framework; show how they fit into larger processes
- ☐ Include activities that help develop higher levels of learning (evaluation, analysis) as well as lower levels (understanding, applying)

Know your students

- ☐ Analyze your target audience: characteristics and pre-existing knowledge
- ☐ Relate content to what learners already know
- For beginners, provide:
  - ☐ Structure
  - ☐ Detailed explanations
  - ☐ Practice opportunities
  - ☐ An outline at the beginning
  - ☐ Explanation of basic concepts
  - ☐ Worked examples
  - ☐ Multiple examples
  - ☐ Help creating explanations and links to underlying concepts
  - ☐ Multiple varied examples
- For learners with some background, provide:
  - ☐ Minimal explanations
  - ☐ Less detail
  - ☐ Less redundancy (e.g. words or graphics, not both)
  - ☐ Less structure, more control over content (e.g. branching, ability to skip sections)
  - ☐ Problems to solve

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