CDC's E-learning Essentials

A guide for creating quality electronic learning







Center for Surveillance, Epidemiology, and Laboratory Services
Division of Scientific Education and Professional Development

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About This Guide

CDC's E-learning Essentials Guide was developed for course developers and training decision makers who are new to e-learning. The guide aids in the creation of quality e-learning by identifying key instructional components and summarizing what they are, why they are important, and how to use them most effectively. The guide does not provide step-by-step instructions to create e-learning. For best use of the guide's information, some experience in education, adult learning, or instructional design is recommended. Information on the instructional design process and a **glossary** of frequently used terms are located in the **Instructional Resources** section.

Consultants for the development of this guide include the Scientific Education nd Professional Development Program Office (SEPDPO), Educational Design and Accreditation Branch (EDAB); CDC's eLearning Workgroup (eLWG), and Usability.gov, among others listed in the **Instructional Resources** section.

E-learning Defined

CDC's eLearning Workgroup defines e-learning as "instruction accessed through computerized electronic technologies, such as the Internet, intranet, compact disc, mobile devices, or other digital media" (CDC eLWG 2011). Designed specifically to support distinct learning objectives through a variety of instructional strategies, e-learning requires active engagement and interaction by the learner to meet objectives and achieve intended outcomes (Gathany 2012). E-learning is just one method of instruction; it can and often should be combined with other methods, such as printed materials and instructor-led training to reinforce learning.

E-learning Development

The design and development of effective e-learning is a complex process that requires a number of analytic activities to help ensure that learning takes place, and many of these activities must occur several times within the process of developing a product. Also, different components within the design of an e-learning product can address similar purposes that often overlap and merge. The "ADDIE" model (Analysis, Design, Development, Implementation, and Evaluation) represents five distinct stages in the creation of e-learning (Molenda 2003). Although ADDIE is recognized as the definitive process model for instructional design and training development, it is important to keep in mind that the development process is rarely linear, as ADDIE suggests, but spiraling and iterative.

For more information on the ADDIE model and other instructional design processes, see the **Instructional Resources** section. For functional examples of quality e-learning products that follow the points highlighted in this guide, see **E-learning Examples** on CDC's Learning Connection Web pages.

Exit Notification/Disclaimer Policy

- This guide includes links to websites that provide helpful information for developing quality e-learning products. This graphic notice (⧉) means that you are leaving a Department of Health and Human Services (HHS) website. Although the link leads to a site that is consistent with the intended purpose of this federal website, HHS cannot attest to the accuracy of a non-federal site. Linking to a non-federal website does not constitute an endorsement by HHS or any of its employees of the sponsors or the information and products presented on the site. You will be subject to the destination website's privacy policy when you follow the link.
- This guide discusses components and best practices for e-learning and provides examples that do not constitute endorsement of any product by CDC or the federal government, and none should be inferred.

References

CDC eLearning Workgroup. 2011 Comments collected for a working definition of e-learning.

Gathany, Nancy C. 2012. Proquest. Expert Instructional Designers' Views of the Impact of Accessibility Requirements on E-learning Instructional Strategies.

Molenda, Michael. "In Search of the Elusive ADDIE Model," Performance Improvement accessed Jan 2011, doi: 10.1002/pfi.4930420508.

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Key Instructional Components and Best Practices

E-learning developers from across CDC have identified the following components and best practices as those that are essential to quality e-learning.

For more information, click the component link in the left column to go directly to that section within the guide.

Figure 1
E-learning components and best practices, as identified by CDC's e-learning developers

Component	Best Practice
Analysis	E-learning products are based on results of analyses that identify learner audiences and inform their needs by focusing on ■ Knowledge or skills to be learned ■ Clear and measurable learning objectives ■ Strategies that support learning
Interactivity	E-learning products facilitate learning by applying interactive strategies that engage learners and stimulate recall of prior knowledge. Different levels of interactivity may be used to suit content and audience needs. All interactions work within the organization's web architecture and meet the organization's accessibility requirements, such as Section 508.
Interface and Navigation	E-learning interface is learner-friendly with a main menu and other navigational elements that help learners know where they are within the course and move easily through it.
Content	E-learning content is accurate and reading level is appropriate for the audience. Information is succinct, logical, and clearly divided through the effective use of color, graphics, borders, and white space. All screen elements adhere to organizational guidelines for digital media.
Product Evaluation	E-learning products undergo formative and summative evaluations to ensure that learning strategies are effective and long lasting.
Learning Assessment	E-learning products include an assessment that can be completed by all learners. This assessment determines the product's impact on intended learning outcomes.

Analysis

Best Practice

E-learning products are based on results of analyses that identify learner audiences and inform audience needs by focusing on

- **Knowledge or skills to be learned**
- **Clear and measurable learning objectives**
- **Strategies that support learning**

An instructional analysis focuses on the learners, what they need to know, and the skills required for them to achieve specific learning objectives. Analyses are conducted to inform instructional strategies and other components of training. For e-learning that is relevant and appropriate, a thorough analysis must be performed before the developer begins product development.

Instructional Analysis

The following are fundamental questions that form the basis of an instructional analysis. Answers to these questions drive the planning, identification of learning objectives, and design of a learning product. Analysis of the project is always the first step in developing any training.

- Why is e-learning being developed, as opposed to another method?
- Is the goal to provide information or to improve skills?
- When is the product needed?
- What do the learners already know about the topic? What knowledge or information must learners have before taking this course? Is this an introductory, intermediate, or an advanced skills course?
- Who is the audience? What characteristics identify the audience? Where do they work? How many will take the course? What is their level of education? How comfortable are they with using a computer?
- Who will provide content? How will you ensure that content is accurate and complete?
- Are subject matter and desired outcomes suited to instruction through e-learning?
- What is the learners' motivation for taking this training? Will continuing education (CE) be available upon completion? Will the course meet a job requirement?
- What instructional approach is best to train this audience in the skills to be learned?
- What specifically does the audience need to learn? Is it available from other sources?
- What is the audience expected to do after completing the training? How will learners improve their job performance in a measurable way?

Answers to these questions help determine learning objectives and assessment measures.

Learning Objectives

Learning objectives are statements placed at the beginning of a course to inform learners about the course's content. Learning objectives also help an e-learning designer create a course to the specifications of audience needs and learning outcomes. Most e-learning designers use a revised version of Bloom's Taxonomy to help craft learning objectives. Bloom's Taxonomy categorizes actions for lower and higher orders of thinking and provides specific verbs to help clearly describe a desired outcome of a learning activity within those orders (Anderson, Lorin, and Krathwohl 2001).

Useful learning objectives have the following SMART (Doran 1981) characteristics:

S — Specific: Clearly identifies a particular knowledge or skill that learners are expected to demonstrate following training

M — Measurable: Knowledge or skill can be quantified through assessment

A — Action-oriented (attainable): Active verbs are used to represent the behavior being measured

R — Reasonable (relevant): Knowledge or skill can be attained within the time, scope, and other conditions of training and relevant to the needs of the program and the learners

T — Time-bound: Include the time-frame in which learners are expected to achieve objectives, usually by the end of training.

Figure 2 provides examples of learning objectives that can be achieved and evaluated in an e-learning environment.

Figure 2
Examples of effective learning objectives

Example 1 from CDC Field Deployment training

Upon completion of this course, you will be able to

- Describe the domestic deployment process
- Describe the international deployment process
- Describe how you can plan ahead and prepare yourself for deployment
- Determine the next steps to prepare for your role as a CDC responder

Example 2 from CDC Telework Training for Employees

After completing this course, learners will be able to

- Identify the different categories of telework agreements
- List the eligibility criteria for participation in CDC's Telework Program
- Identify reasons an employee can be denied participation in CDC's Telework Program
- List the necessary equipment, information, and services for telework arrangements
- Determine the course of action needed to resolve telework issues

See the **Instructional Resources** section for Bloom's Taxonomy and more information on developing effective learning objectives.

References

Anderson, Lorin W. and Krathwohl, David R., eds. 2001. A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives: Complete Edition. New York: Longman.

Doran, George T. 1981. "There's a S.M.A.R.T. Way to Write Management's Goals and Objectives." Management Review: 35.

Interactivity

Best Practice

E-learning products facilitate learning by applying interactive strategies that engage learners and stimulate recall of prior knowledge. Different levels of interactivity may be used to suit content and audience needs. All interactions work within the organization's Web architecture and meet the organization's accessibility requirements, such as Section 508.

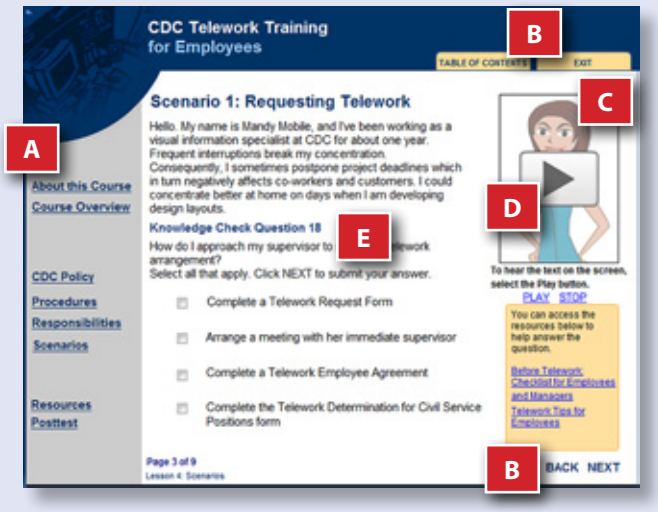
Interactivity provides opportunities throughout the e-learning course that allow learners to explore content, apply knowledge, and check understanding through questions (Donahue 2005), simulations and other activities that require learners to use screen-based controls. Interactivity is the primary distinction between e-learning and other media, such as Web pages, that are more suited for informational purposes.

True interactivity involves a "dialogue," requiring a learner's response to course stimuli and the course's feedback to that response. By interacting with the content and making decisions about the information presented, learners become active participants, triggering recall and improving understanding and knowledge retention.

Because interactivity enhances the learning experience, it is one of the most important elements in instructional design; however, highly interactive content can render a product inaccessible to some learners. Remember, as a federal employee you must comply with Section 508 of the Rehabilitation Act of 1973. Federal agencies that develop, procure, maintain, or use electronic and information technology must ensure accessibility. See **Section 508** in the **Instructional Resources** section for guidance and more information on developing accessible products.

Figure 3
Examples of interactivities from CDC Telework Training

- A Hyperlinks
- B Navigation
- C Graphics and Animation
- D Audio and video controls
- E Exercises and assessments



Levels of Interactivity

The four levels of interactivity for e-learning, as described by Lange 2006, Gathany 2012, and the U.S. Department of Defense 1999 are provided below.

Level 1—Passive

Characterized by passive learner engagement and a linear structure, Level 1 interactions are used primarily to introduce an idea or a concept . The learner has no control over the sequence or the timing of activities within the course. Level 1 e-learning might consist of static content, such as a Web page, and an assessment activity. These interactions are appropriate when there is a need to share information quickly, or when the information does not involve a procedure that affects how the learner will perform a job-related task.

Level 2—Limited Interactions

Level 2 offers the learner more control over the sequence and presentation of content than the linear structure of Level 1. With limited interactions, the learner makes simple responses to instructional cues, such as multiple choice questions and hyperlinks. Feedback to responses is an important part of limited interactions that reinforce learning.

Level 3—Complex Interactions

Level 3 interactions are complex, allowing the learner even more control of how information is presented using audio, video, graphics, animations, screen alternation, simulations and scenarios, or combinations. Interface and navigation often include two or three **branches** to support alternation between screens, and progression through the course can be determined by the learner.

Level 4—Real-time Interaction

Level 4 interactions are typically used for content that is very complex and can involve the learner in simulations that are based in real-time with real-time assessments. This level involves a detailed presentation, allowing the learner almost full control over content. Level 4 e-learning might apply several branches that use multiple menus, animation and video. Training at this level is often held in a collaborative environment with other learners and a facilitator. Meeting accessibility requirements is a challenge with Level 4 interactivities, and creating a Level 4 product requires highly interactive courseware and Internet technology.

Interactivity Levels 1 through 3 can produce extremely engaging e-learning without being complicated. For more information on interactivity and a variety of examples, see the Instructional Resources section.

Selecting Interactivities

Interactivities should never be selected or placed arbitrarily within a course. The following are some important considerations for decisions about the use of interactivity:

- What interactions would engage the audience?
- Can a Section 508-compliant interaction be developed to mimic actual, desired, post-training performance?
- How often does the learner need to interact to check understanding of the content?
- Are there opportunities to provide collaborative interactions by using Web 2.0 features, such as a wiki or a blog?
- Is the content linear, or are there multiple paths? Will branching be needed? If so, what media can best influence learner behavior?

The following table lists reasons for choosing interactive elements and strategies for making the interaction relevant to the content.

Figure 4
Use of interactive strategies (Donahue 2005)

Reasons for Interaction	Strategy
Explain and support concepts	■ Use to emphasize key concepts or highlight key points ■ Use to provide structure to detailed or complex content ■ Use to allow learner control over content/sequencing ■ Use to challenge learners prior to introducing new concepts
Practice and apply learning	■ Make practice opportunities meaningful and interesting ■ Use after presenting key concepts ■ Use when knowledge/skills need to be internalized ■ Use to help learners differentiate between good and poor performance
Check learner understanding to determine if course objectives are being met	■ Directly relate questions to at least one module objective ■ Provide positive reinforcement that the user is making progress ■ Provide positive intrinsic feedback that demonstrates the ineffectiveness or risks of poor responses and the value of good responses

Reprinted by permission of Monique Donahue. (2005) "The Design Document: Your Blueprint for e-Learning Standards and Consistency"

References

Donahue, Monique. (2005) "The Design Document: Your Blueprint for e-Learning Standards and Consistency." Learning Solutions EMagazine. eLearning Guild.

Lange, M. 2006. eLearning: From Level I to Level IV of Interactivity: Why choosing the appropriate interactivity level is important. Entelysis Technologies.

Gathany, Nancy C. 2012. Expert Instructional Designers' Views of the Impact of Accessibility Requirements on E-learning Instructional Strategies. ProQuest.

United States Department of Defense. 1999. Development of Interactive Multimedia Instruction Handbook, Part 3 of 4 Parts, 43-52.

Interface and Navigation

Best Practice

E-learning interface is learner-friendly with a main menu and other navigational elements that help learners know where they are within the course and move easily through it.

The interface, or the appearance and layout and of an e-learning course, is the point at which the course communicates with the learner, determining how a learner will engage. Navigational elements contribute to the interface and how a learner moves through the course environment. As part of the overall look, functionality, and design of a course, interface and navigation have an enormous impact on the learning experience, and a poorly designed interface detracts from learning. This section focuses on interface design for e-learning; the **Content** section highlights written, graphic and multimedia aspects of e-learning.

Figure 5
Example of a well-designed interface from CDC Yellow Fever training



Design Practices

Consider the following standard practices when designing the interface and navigation elements of an e-learning course:

- Navigation is clear to learners who have limited Web and computer experience.
- Next and Back buttons are located at lower right of the screen.
- Learners can exit the course and resume work at the place where they stopped.
- Feedback is provided on the learner's location within the course.
- The content is indexed so that learners can find the information they seek easily.
- Navigational options, such as menus and a table of contents are provided.
- Text and graphics are balanced with a use of adequate white space for an uncluttered screen.
- A template has been used to help ensure consistency of branding and identity, fonts, colors, layout and other design elements throughout the course.
- Related information is chunked for ease of scanning.
- Lists and processes are serialized by using bullets or numbers.
- Tab labels are short and descriptive.

A checklist is helpful to ensure that all elements necessary for the interface and ease of navigation have been used throughout the course, as appropriate. Those elements include, but are not limited to the following:

- Numbered pages
- Table of contents or menu
- Home and Exit buttons
- Course information tabs
- Links to scenarios and case studies
- System requirements
- Tab links to additional information, such as Resources, References and Glossary
- Steps
- Questions and answers
- Tips and hints
- Definitions
- Pop-up windows
- Print and Close windows, icons, buttons or links

Content

Best Practice

E-learning content is accurate and reading level is appropriate for the audience. Information is succinct, logical, and clearly divided through the effective use of color, graphics, borders, and white space. All screen elements adhere to organizational guidelines for digital media.

Screen content, or the interface of an e-learning course, typically contains text, graphics and interactive tools that work together to help explain concepts and provide instruction. All of these elements, as they are written, formatted and positioned, convey meaning, whether or not the desired message is conveyed. The right combination of text, graphics and audio-visual interactions can mean the difference between e-learning success and failure. In other words, although information on a screen might be complete and correct, the way it is presented might confuse or distract a learner, making intended outcomes difficult to achieve.

Much of the content for an e-learning course is provided by subject matter experts (SME). Instructional designers repurpose that content according to learning objectives and audience needs. This section provides basic information on effective writing and use of graphics and multimedia for the purpose of e-learning. See **Interface and Navigation**, for more information on designing these elements for the e-learning environment. The federal website, **HowTo.gov** at http://www.howto.gov/web-content provides extensive guidance to help federal agencies provide quality content through digital media.

Text

Writing for a screen is different from writing for a printed page (Garrison 2003), and writing for the purpose of e-learning is even more different than writing for other digital media (Calhoun 2006). Although e-learning should follow the basic writing principles with accuracy, clarity and conciseness, effective writing for e-learning should also employ a more conversational, informal style than traditional prose. For guidance on improving the organization and clarity of materials produced by the federal government, visit the **Federal Plain Language Guidelines Tips and Tools** Web pages at http://www.plainlanguage.gov/howto.

Use of second person, short paragraphs and two-word sentences that are not considered appropriate practices for conventional writing are often recommended for e-learning. Because most e-learners scan screens to obtain information quickly, nonessential information, complex sentences, and strings of words with multiple syllables have no place in an e-learning course.

A **content developer's checklist** is provided as an example in the **Instructional Resources** section. Other, more specific guidance should be established by your organization. Following are general principles for writers of e-learning:

- Identify objectives of the course, and use them to drive all content and eliminate unnecessary information.
- Organize concepts logically, and check for gaps in information.
- Place the most essential, key messages at the beginning of e-learning courses, sections, paragraphs, and sentences.
- Keep language simple, concise and consistent.
- Use a conversational style with active voice, present tense, and second person, as appropriate.
- Write to a reading level that is appropriate for the audience, and use a **readability index or formula** to check the reading level.
- Allow learners to "click for more information" in areas that are text-heavy by providing a downloadable job aid, a link to another site, or a wiki.
- Avoid jargon, slang and idiomatic expressions that are not universally understood.
- Use bold and italic fonts only occasionally to highlight particular phrases or words.
- Avoid using all capitalized letters and underlines.
- Have a technical editor review content and ensure that meaning, grammar, and spelling are correct.

Graphics

A course using text only is inadequate for learners with diverse learning needs and does not constitute true e-learning. Graphics, such as charts and other images, are used to explain or enhance written information, not replace it or detract from it. All graphic elements should increase understanding and accessibility of content for learners.

The following are general principles for the use of graphics in digital media:

- Ensure that graphics are accurately described with the appropriate alternative text.
- Tabular data is displayed within a simple table that is clear and accessible.
- When there is no other way to make an image accessible, such as a table or flow chart, provide a separate text version to meet accessibility requirements.
- Check to ensure screen resolution is functional and appropriate for the audience.
- Ensure that images enhance the content.
- Allow learners to "click for more information" in cases where images might need more explanation, and provide a downloadable job aid, or link to another site or a wiki.

Multimedia

Narration, video, animation and other multimedia, in combination with text and graphics, can increase understanding and enhance the learning experience. The engagement and repetition offered by using multimedia can help the learner to retain information. With a balanced mix of content through a variety of media formats, the learner's motivation and attention also increase.

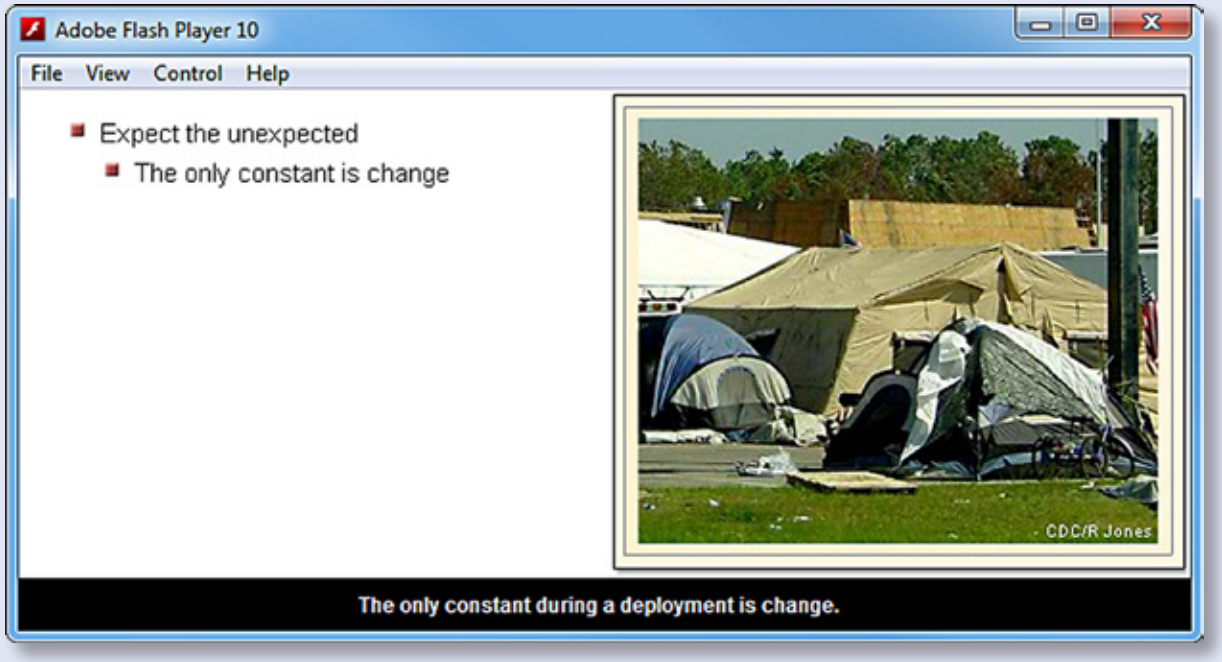
Use multimedia for the following purposes:

- Highlight important content
- Present a story or scenario
- Provide examples

Remember that multimedia is a point of interactivity and should be selected on the basis of the same considerations listed in the Interactivity section. Multimedia should never be selected or placed arbitrarily within a course. Following are some important considerations for decisions about the use of multimedia interactions. See **Interactivity** for more information.

- What type of multimedia will engage the audience?
- Can Section 508-compliant multimedia be developed to mimic actual desired post-training performance?
- How often does the learner need to interact to check understanding of the content?
- Are there opportunities to collaborate through multimedia by using Web 2.0 features, such as a blog or a wiki?
- Is the content linear? Will branching be needed? If so, what media can best influence learner behavior?

Figure 6
Example of video used with closed captioning, CDC Incident Management training.



http://www.cdc.gov/training/products/essentials

References

Calhoun, Harry. 2006."Why is writing for e-learning different?" Training, VNU Business Media.

Garrison D.R., Anderson T. 2003. E-learning in the 21st century: A Framework for Research and Practice. New York: RoutledgeFalmer.

Product Evaluation

Best Practice

E-learning products undergo formative and summative evaluations to ensure that learning strategies are effective and long lasting.



Although instructional designers might have the skill and experience to develop e-learning for a variety of audiences, they might never know if any of those products are effective until there is evidence. An evaluation provides evidence by collecting learner feedback about a product. This information can also improve a product. As such, evaluation is an integral part of the e-learning development process that never should be overlooked (National Research Council 1998).

Formative Evaluation

In the context of e-learning, a formative evaluation is but one quality assurance check before a product is released to learners. Formative evaluation ensures that problems that can hinder learning are detected and corrected. Although some formative evaluations can be simple and informal, they can be quite effective (Clark 2004).

A formative evaluation is conducted during the design and development of a product. Because a formative evaluation is intended to improve a product before it is delivered, a mock-up or prototype can be used to represent ideas before they are incorporated into a finished product. If a paper prototype is first used, as the product comes closer to completion, the developer might conduct more than one formative evaluation to gain input. Peer reviews, pilot tests, and usability tests are all formative evaluation methods that require only about five persons to complete. Those persons might include co-workers who review specific aspects of a course, such as instructional strategies, usability, functionality, and the overall learning experience.

Summative Evaluation

Summative evaluation is focused on learning outcomes and is, therefore, conducted after a product has been developed and implemented. Although conducting an evaluation after a course is delivered will not improve that particular course, it can provide valuable information to improve future courses. Because summative evaluation examines results from larger groups to determine if learners learned what was intended, it is often considered more valid and reliable than formative evaluation (Reeves and Harmon 1994, Scalise and Gifford 2006).

A summative evaluation seeks to answer the following questions:

- Is the product effective in achieving intended results?
- Are changes in learner performance directly related to the product and its learning strategies?

These questions are answered primarily through self-report from learners, observer judgments, job performance indicators, and learner testing at selected intervals following product delivery.

For more information on **e-learning product evaluation**, see the **Instructional Resources** section.

References

Clark, Donald R. 2004. Types of Evaluations in Instructional Design. Accessed January 2010.

National Research Council.1998 "Design and Evaluation: A Review of the State of the Art." D-Lib Magazine.

Reeves, Thomas C., and Harmon, Stephen W. 1994. "Systematic Evaluation Procedures for Interactive Multimedia for Education and Training." In Multimedia Computing: Preparing for the 21st Century. Edited by Sorel Reisman, 472-505. Harrisburg, PA: Idea Group Publishing.

Scalise, Kathleen, and Gifford, Bernard. 2006. "Computer-Based Assessment in E-Learning: A Framework for Constructing "Intermediate Constraint" Questions and Tasks for Technology Platforms." Journal of Technology, Learning, and Assessment, 4(6).

Learning Assessment

Best Practice

E-learning products include an assessment that can be completed by all learners. This assessment determines the product's impact on intended learning outcomes.

Within the context of e-learning, an assessment is any interaction from which data is collected with the intent of making an inference about the learner (Scalise 2006). Assessment provides practical, objective, and measurable evidence that learning goals are achieved, and ensures a degree of product integrity. Because e-learning assessment methods provide results quickly, training decisions also can be made quickly. Moreover, assessment improves learning through interaction and feedback, identifies learner knowledge strengths and weaknesses, and helps to evaluate the effectiveness of the instruction (Bloxham and Boyd 2007).

Assessment Types

- Diagnostic: Conducted before instruction to determine learner skill level; pretest. Requires posttest.
- Formative: Conducted at intervals during instruction to determine learner's level of understanding of specific topics.
- Summative: Conducted at the end of instruction to determine knowledge gained from course's overall content; posttest.

The following questions should be answered to help determine an appropriate assessment type for a course:

- Is there a need to know learner skills before training begins?
- Does content require knowledge checks after the introduction of each concept or topic?
- Will learner knowledge or performance be reevaluated in the months after the course is completed?
- Is there a learning community feature, such as a wiki or discussion board, that would allow for long-term learner feedback and continuous improvement?

Question Development

The most effective assessment techniques include the development of realistic scenarios and questions to match the learning objectives (Thalheimer 2002). For information on scenarios and question development, see the **Instructional Resources** section.

Overall, questions should do the following:

- Provide clear instructions
- Match learning objectives
- Place correct answers in random positions and not in a detectable pattern
- Include meaningful feedback that reinforces learning
- Not be unreasonably difficult, requiring learners to spend more time analyzing what is asked rather than selecting answers
- Use clear, concise, and precise language

- Test one idea per item
- Contain only material relevant to the answer
- Be reviewed by a subject matter expert and by someone not familiar with the subject
- Be edited for clarity and grammar

Questions should not…

- Reveal answers
- Have the ability to be interpreted in more than one way, or have answer choices whose differences are too subtly different

Distracters

Distracters are the incorrect answers to each question. Distracters can directly affect the difficulty of a question by being obviously incorrect, or too closely related to the correct answer.

Well-constructed questions apply the following rules for distracters (Intelligent Assessment Technologies 2011):

- Distracters seem completely reasonable to the unprepared learner.
- Distracters are based on content within the course.
- Distracters are similar to the correct answer in construction and length.

Formats

Popular question formats used by e-learning developers are described below:

- Drag and drop: Learners respond to a task, such as sequencing or arranging, by clicking on an object and dragging it to a different location or onto another object.
- Fill-in-the-blank; short-answer: Variations of multiple-choice; learners complete a sentence by selecting the answer from a list of possibilities.
- Hot Spots: Learners select the answer to a question by clicking on the correct area of an object.
- Matching: Learners match relationships between items on a paired list.
- Multiple-choice: A question is presented, and the learner selects one correct answer from a short list of possibilities.
- Select-all: A variation of multiple-choice; learners can select a number of answers from a list of possibilities that apply to a question.
- True-false: A statement is presented and learners select whether the statement is true or false.

Many developers generally find multiple-choice, fill-in-the-blank, true-false, and select-all formats easy to design, simple for learners to execute, and compliant with accessibility guidelines. Matching, drag and drop, and hot spots can require more advanced e-learning development skills and enhanced computer capabilities.

When determining the most appropriate question format for e-learning assessment, the following should be considered:

- Level of thinking actions to assess (from **Bloom's Taxonomy**)
- Hardware and software capabilities
- Information to be collected, stored, processed, and secured
- Interface and accessibility

The following sample questions are adapted from "Simulation-like questions: How and why to write them" (Thalheimer 2002).

Multiple-choice

Select the best answer.

Your assessment questions are scenario-based, but you can't decide which format to use. Which of the following formats best promotes learner recall for job performance following training?

- ○ A. True-false questions
- ○ B. Multiple-choice questions
- ◉ C. Fill-in-the-blank questions
- ○ D. All of the above
- ○ E. None of the above

Feedback C is correct. In general, fill-in-the-blank and short-answer questions produce better assessment results than multiple-choice questions, and multiple-choice questions are better than true-false questions.

True-false

Determine if the following statement is true or false.

True-false questions should be used often because they provide the most valid and reliable assessment data.

- ○ True
- ◉ False

Feedback False. True-false questions should be used sparingly because they are typically simplistic, and they have only two possible answers. This results in high scores from merely guessing correctly, producing invalid results.

Fill-in-the-blank/Short answers/Select-all

Select all that apply to complete the sentence below.

Distracters can directly affect the _____ of a question by being obviously incorrect or too closely related to the correct answer.

- ◉ A. Difficulty
- ◉ B. Reliability
- ○ C. Length
- ○ D. Negativity

Feedback A and B are correct. Inserting an obviously incorrect choice increases the learner's chances of guessing correctly. Distracters that are too closely related to the correct answer can cause a learner who knows the answer to become confused and spend too much time trying to understand meaning. These kinds of distracters compromise the reliability of the assessment data.

For more information on question development and formats, visit Learning Assessment and Question Development in the **Instructional Resources** section.

References

Bloxham, Sue and Boyd, Pete. 2007. Developing Effective Assessment in Higher Education: a Practical Guide. New York, NY: Open University Press, McGraw-Hill.

Intelligent Assessment Technologies. 2011 "Writing Good MCQs" Copyright © Intelligent Assessment Technologies Limited.

Scalise, K. and Gifford, B. 2006. "Computer-Based Assessment in E-Learning: A Framework for Constructing 'Intermediate Constraint' Questions and Tasks for Technology Platforms." Journal of Technology, Learning, and Assessment, 4(6).

Thalheimer, Will. 2002. Simulation-like questions: How and why to write them. Work-Learning Research.

Conclusion

For functional examples of quality e-learning that follow the main points of this guide, see E-learning Examples on CDC's Learning Connection Web pages.

Send your comments and suggests about this guide to learning@CDC.gov.

Instructional Resources

In addition to CDC subject matter experts and previously listed references, the following resources were consulted to create this guide. E-learning developers will find these resources useful.

Topics	Resources
E-learning at CDC	CDC eLearning Workgroup (eLWG) http://intranet.cdc.gov/cdcweb/mgmt_gov/workgroups/E-Learning.htm (Accessible only on CDC Network)
	CDC Learning Connection http://www.cdc.gov/learning
	Scientific Education and Professional Development Program Office, Instructional Design Services http://intranet.cdc.gov/osels/sepdpo/DLP/edab/instructional_design.html (Accessible only on CDC Network)
Glossary	CommLab India. Copyright © 2000 - 2012 CommLab India. All rights reserved. http://www.commlabindia.com/elearning-resources/elearning-glossary.php
Analysis and Instructional Design	Allen, W. C. 2006. "Overview and Evolution of the ADDIE Training System," Advances in Developing Human Resources, 8(4): 430-441. Available online at http://adh.sagepub.com/content/8/4/430.full.pdf+html
	ASTD's Instructional Design Process and Theory Module 1 Sample at http://www.astd.org/Publications/Books/ASTD-Learning-System/~/media/5C64A3AA39324394A318F42FC67F16F9.ashx
	Penn State Learning Design Community Hub at http://ets.tlt.psu.edu/learningdesign/
	Donahue, Monique. 2005. "The Design Document: Your Blueprint for e-Learning Standards and Consistency," Learning Solutions EMagazine. eLearning Guild. Available online with subscription at https://www.learningsolutionsmag.com/subscribe
Usability	Usability.gov at http://www.usability.gov/

Topics	Resources
Accessibility	Accessibility Guide for Lectora® 2008 http://www.cdc.gov/training/products/Accessibility508 (Accessible only on CDC Network) CDC.gov Templates http://knowledgeshare.cdc.gov/08._Web_Development/CDC.gov_Internet_Templates Guidance on Section 508 for the Web http://intranet.cdc.gov/cdcweb/usability/508/index.html (Accessible only on CDC Network) Formatting and Content Elements on HowTo.gov at http://www.howto.gov/web-content
Writing for E-learning	Developer Checklist Example Style and Compliance Checklist at http://www.cdc.gov/learning/local/pdf/Style_Compliance_Checklist.pdf Checking Readability in MS Word http://office.microsoft.com/en-us/word-help/test-your-document-s-readability-HP010148506.aspx Plain Language http://www.plainlanguage.gov
Bloom's Taxonomy	Anderson, Lorin W. and Krathwohl, David R., eds. 2001. A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives: Complete Edition. New York: Longman.
Developing Learning Objectives	Penn State Learning Design Community Hub at http://ets.tlt.psu.edu/learningdesign/objectives Writing Measurable and Observable Learner Outcomes: Assessment of Learning Outcomes at http://www.wisha.org/CE/Writing_Learning_Outcomes_and_ Assessment_of.pdf
Scenario Development	Elearning! Magazine. Scenario-based Learning at http://www.2elearning.com/www/magazine/articles/single-news-article/article/scenario-based-learning.html.

Topics	Resources
Interactivity	Donahue, Monique. (2005) "The Design Document: Your Blueprint for e-Learning Standards and Consistency." Learning Solutions EMagazine. eLearning Guild. https://www.learningsolutionsmag.com/subscribe Schone, B. J. 2007. Engaging Interactions for eLearning: 25 Ways to Keep Learners Awake and Intrigued. Available at http://www.elearningpulse.com/eBook/EngagingInteractionsForELearning.pdf Penn State Learning Design Community Hub at http://ets.tlt.psu.edu/learningdesign/lessons/feedback
Learning Assessment and Question Development	Scalise, Kathleen, and Gifford, Bernard. 2006. "Computer-Based Assessment in E-Learning: A Framework for Constructing "Intermediate Constraint" Questions and Tasks for Technology Platforms." Journal of Technology, Learning, and Assessment, 4(6). Accessed January 14, 2011 at http://escholarship.bc.edu/jtla/vol4/6/. Penn State Learning Design Community Hub at http://ets.tlt.psu.edu/learningdesign/effective_questions Thalheimer, W. 2002. Simulation-like questions: The Basics of How and Why to Write Them. Work-Learning Research. Available online at http://www.speakeasydesigns.com/SDSU/student/SAGE/compsprep/Simulation-like_Questions_How_and_Why.pdf Intelligent Assessment Technologies. Copyright © Intelligent Assessment Technologies Limited 2011. http://www.intelligentassessment.com/writing_good_multiple_ choice_ questions.htm
Product Evaluation	e-Learning Style Guide for the Virginia Department of Health . Available online at http://www.docstoc.com/docs/28844147/e-Learning-Style-Guide-for-the-Virginia-Department-of-Heal. Reeves, Thomas C., and Harmon, Stephen W. 1994. "Systematic Evaluation Procedures for Interactive Multimedia for Education and Training." In Multimedia Computing: Preparing for the 21st Century. Edited by Sorel Reisman, 472-505. Harrisburg, PA: Idea Group Publishing. Brandon Hall and Arjun Reddy. Developed in 1998 (MM&ITNL,Brandon-Hall) for Evaluation of E-Learning programs. 2002. Available online at www.kinchew.com/Quality-EL/Brandon-Hall-Eval-Criteria.doc

Notes

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