getting started with e-learning
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Welcome to the engaging world of e-learning!

This is an extremely exciting time to be in the learning field. The advent of the World Wide Web and rapid advancements in Web-authoring software have created the possibility of delivering compelling electronic-learning to new groups of learners, and for new classes of applications. At the same time, rapid technical innovation is surmounting the bandwidth barrier of the Web and enabling the delivery of online content that is truly interactive and media-rich. While the potential for creating compelling e-learning is enormous, tapping that potential is not always easy. We hope that this book can help you to navigate the complexities of developing and delivering e-learning and unlock the potential of the Web.

Macromedia has provided tools for computer-based learning since the early days of CD-ROM. Released in 1987 as Course of Action, today's Macromedia Authorware was the first visual authoring product designed specifically to serve the needs of learning developers. In 1992, Macromedia was formed and the company's offerings expanded to include Director, now the industry standard for creating powerful multimedia applications. Today, Macromedia provides a comprehensive array of software for designing and delivering the most exciting content and sites on the Web. Not surprisingly, almost all of these products are used by creative designers and enterprising developers to deliver e-learning applications. Our primary challenge with our learning customers has become helping them determine which software is right for their job.
This book is designed to help new authors create learning applications that succeed. The first step is to choose the best software for your specific application and delivery requirements. Unfortunately, this is not always a simple task. Each authoring product has strengths that make it uniquely suited to a particular training task and each is designed with a particular user in mind. Ultimately, the development of many learning applications requires using a combination of authoring products. Since Macromedia software and Web technologies are evolving so rapidly, we have released an online chapter, “Choosing your solution,” to address this question. This chapter is distributed on the Web so that we can update it to keep pace with changing technologies. To download the latest update, please visit the Macromedia Web site, www.macromedia.com/learning/.

Selecting an authoring solution is only the first step. Creating and delivering e-learning applications can be a complex task and almost every beginning author needs assistance. Developers need to know about such diverse topics as instructional design, multimedia, authoring software, data tracking, and networks. Macromedia authoring software is used today by thousands of developers who create many of the best e-learning applications available. Over the years, our customers have provided us valuable insight into the challenges faced by learning developers. This guide attempts to help you meet the most common of these challenges.

Getting Started with E-learning covers three major areas: technology, design, and integration. The chapter, “Choosing Your Solution,” helps authors make sense of the rich array of Macromedia authoring software and technologies from which they can choose.

The first two chapters in this guide address common design challenges. Chapter 3, “Instructional Design for E-learning” on page 69 introduces ways to develop effective learning content. Chapter 4, “Converting Traditional Courses to E-learning” on page 101 provides a roadmap and suggestions for one of the most common tasks for a first-time author: converting a classroom-based course to an online course.

Chapter 5, “Developing for Low Bandwidth” on page 131 provides advice on how to get the most out of Macromedia authoring software and optimize your content for the Web.

The last two chapters tackle the topic of integration. In addition to course content, what other components are required to deploy a fully-featured e-learning course? How do you integrate these components? Chapter 6, “Options for Data Tracking” on page 147 helps authors understand the different ways to collect student and course data. Finally, Chapter 7, “Deploying Your E-learning Course” on page 171 reviews all the possible components of your e-learning course and the process and options for putting them all together.
To create a book filled with practical, real-world information, we have collaborated with three authors who have a combined 37 years of experience in developing and delivering e-learning. William Horton is an independent consultant to corporations on e-learning and the author of *Designing Web-based Training*, a leading book on the subject. Betsy Bruce is a professional developer who has created extensive e-learning projects for the Web, corporate networks, and CD. She is also the author of *Sams Teach Yourself Macromedia Dreamweaver 3 in 24 Hours*. Carol Fallon is president of Integrity eLearning, a consulting firm that has delivered hundreds of hours of online courseware. Her firm also developed and markets the first AICC Web-certified learning management system. To complement these authors considerable knowledge, we’ve drawn upon the skills and experience of Macromedia employees in product management, technical support, and engineering.

This book is just one of the many resources that Macromedia makes available to our learning customers. We also offer assistance through product documentation and online help systems, support centers, authorized training centers, e-learning courses, and of course the Macromedia Web site. I encourage you to become familiar with this Web site, as it may be your most valuable asset. There you will find many resources designed specifically for the learning developer such as samples, tutorials, case studies, links, and more. Be sure to check the Macromedia product exchanges for learning extensions that simplify and accelerate the development of your learning content. If you’ve created a handy extension, you might even submit and share it with your colleagues!

We hope *Getting Started with E-learning* provides you with useful information and helps you get started on the right foot. Each chapter includes references to additional resources to help you develop skills and knowledge both on your own and with the legions of other learning developers who have embarked on this same exciting journey.

Christian Vescia, Editor
Senior Product Manager
Macromedia
CHAPTER 1
Macromedia Authoring Solutions for E-learning

Introduction

Macromedia provides a rich array of authoring, design, and server software used to create the most engaging, interactive e-learning applications available today. This chapter of the Macromedia guide to e-learning introduces you to all the Macromedia products for creating learning applications and content. You’ll learn who each product is designed for, what its key applications are, and what unique strengths it has for creating online e-learning. You will see how the products differ and where they overlap. In the end, we hope to provide you with all the information you need to choose the Macromedia products that are best for you.

Since choosing a learning authoring solution is a complex task, Macromedia also provides a chapter called “Choosing Your Solution,” that addresses the issue in detail. You can download this chapter from the Macromedia Web site at www.macromedia.com/learning. “Choosing Your Solution” provides a decision framework and worksheets for evaluating Macromedia authoring software against specific requirements in areas including application requirements, delivery environment, and skill set. This information will help you decide which Macromedia products you want to purchase, or determine which products are the best choices for a given project. You may read “Choosing Your Solution” independently of or together with this chapter. If you are not familiar with the Macromedia product line, we recommend that you read this chapter first. It will introduce you to Macromedia products that will help you get the most out of “Choosing Your Solution.”
Macromedia authoring software

Macromedia provides a range of fully featured authoring tools, including Macromedia Authorware, Director, Dreamweaver, Dreamweaver UltraDev, and Flash. Many of these products integrate with powerful server products such as Macromedia Generator, the Shockwave Multiuser Server, ColdFusion, or other application servers. All are capable of producing engaging and effective e-learning applications. But how are they different, and which product is the best choice for your particular requirements?

It’s important to understand that every authoring product is designed with a primary user and primary application in mind, which is referred to as the product’s design center. A product’s design center affects everything about a given product: the user interface, the feature set, the architecture, and more. The design center for each Macromedia product is different and determines the product’s unique strengths and capabilities. Understanding whom a product is designed for and what it was designed to do will help you determine how well it fits your own application requirements and development capabilities.

Macromedia provides both specialized and general-purpose authoring tools. Macromedia Authorware is a specialized product. It was designed for nonprogrammers who want to create interactive learning content. Other Macromedia products used for creating e-learning, including Macromedia Dreamweaver, Dreamweaver UltraDev, Director, and Flash are general-purpose authoring products. They are built for designers and developers who want to create Web sites and Web content. However, since so much technology-based learning is moving to the Web, these products are increasingly being used to create e-learning as well.

To help learning developers take advantage of all Macromedia products, Macromedia has developed learning extensions to facilitate the creation of common learning elements, including the following:

- **Navigation**: menu systems and basic page-turning frameworks for content organization and presentation
- **Learning interactions**: questions and interactions that include feedback, conditional branching logic, and data tracking
- **Quizzes**: a framework for assembling multiple question interactions into an assessment that is scored and tracked
- **Data tracking**: the ability to track student and course information to databases and industry-standard learning management systems
There are also learning interactions supporting key learning standards for data tracking and content packaging. Macromedia learning extensions do not replicate the functionality of a robust learning authoring product, but they do simplify complex tasks of building interactivity and enabling data tracking with a Web authoring product. By providing prebuilt learning functionality, these extensions make the particular strengths of these products accessible to developers who would otherwise have difficulty going beyond simple content presentation.

Macromedia provides learning extensions that support key standards for online learning, including those developed by AICC, IMS, and ADL. Macromedia learning extensions and samples provide the ability to track data to AICC-compliant learning management systems. Other learning extensions for Dreamweaver offer support for the IMS content packaging specification and the ADL-SCORM tracking API. This means that content created by Macromedia products can be assembled into a curriculum and managed within the context of a learning management system (LMS).

Macromedia delivers learning extensions through the company Web site. Macromedia Dreamweaver, Dreamweaver UltraDev, and Flash each have an Exchange that lets the user community contribute extensions. To view all of the available extensions, visit the Macromedia Exchange at www.macromedia.com/exchange. Other products, such as Director, have downloadable samples that are available on the Macromedia eLearning Resource Center, www.macromedia.com/learning.

**One size does not fit all**

Learning applications are diverse, ranging from simple text-and-graphics tutorials to sophisticated software or hardware simulations. No one product meets this broad range of project requirements equally well. For this reason, learning developers frequently use a combination of products to create their courseware. For example, you might place a powerful Macromedia Flash animation inside your Authorware application, or embed a Shockwave Player-based simulation in a Web site built with Dreamweaver. Fortunately, Macromedia products are increasingly integrated and can be used together to create the most engaging, interactive learning experience possible on the Web.

If you are a beginning developer with a project in mind, you need to decide where to start. The rest of this chapter is dedicated to helping you choose the best software for your particular application requirements.
Authorware

Authorware is the leading authoring software for creating interactive, rich-media learning applications.

Primary use

• Computer-based training
• Web-based training

Primary users

• Training developers
• Subject matter experts

Unique strengths for the learning developer

• Intuitive visual authoring interface
• Prebuilt learning functionality
• Versatile delivery

Of all the Macromedia authoring tools, Authorware, with its unique and intuitive visual interface, provides the greatest ease of use and the highest level of developer productivity for creating learning applications. To build applications, authors drag icons onto a flowline and then fill in the content with simple menus. Minimal scripting or programming is needed to create engaging, interactive applications.

The Authorware icon-based flowchart user interface and a Knowledge Object wizard
The Authorware flowline is also ideal for rapid prototyping. Drag-and-drop icons make it easy to create a prototype application to test with users. You can then modify and improve the design based on their feedback.

Authorware is the most productive authoring software for creating learning applications because it includes so many features that are designed for the learning developer. Learning features in Authorware include built-in logic and interactivity, system functions and variables for tracking student data, and extensive templates and templating capabilities. While general-purpose authoring products may be used to produce e-learning content (and may be your best choice for other reasons), none of them address the full range of learning development tasks with the ease and efficiency of Authorware.

For beginning authors, Authorware provides templates called Knowledge Objects. Knowledge Objects are templates with an associated wizard that prompts users for information about a lesson or a course. Based on user selections, the Knowledge Object produces an application framework complete with elements such as navigation, a login screen, a quiz, and data tracking. The development required to produce a course framework has already been done by the program, so you can focus on populating pages with content.

Finally, Authorware excels at providing versatile delivery of rich-media learning content. Rich-media content is characterized by some combination of graphics, audio, video, and sophisticated animation. Authorware lets you create rich-media content once, and then deliver it anywhere, including on CD, corporate networks, and intranets. When you publish to the Web, the Authorware Web Player maintains a consistent, high-fidelity learning experience across platforms and browsers. Authorware applications can be delivered on both Windows and Macintosh platforms.

**Limitations**

Unlike the Macromedia Flash and Shockwave Players, the Authorware Web Player is not preinstalled on major browsers and operating systems. However, the download and installation process can be automated to be a one-button procedure for the user. The size of the full player is 4.4 MB. Downloading the player is not an obstacle in many intranet environments; however, it can be time-consuming for users connecting over low-bandwidth Internet connections. It may also be an obstacle in corporations with policies restricting plug-ins. Another possible limitation is that Authorware does not provide a comprehensive programming language. This may be viewed as a limitation by developers who prefer to code. Authorware does have a scripting language called Calculation language, though most of the basic logic and interactivity for learning are developed in a visual, drag-and-drop environment.
Examples

• PeopleSoft - Software Training (OnDemand courses)
  www.psknowledgecenter.com/go/free.htm
• Training Café - Teacher IT training
  www.trainingcafe.com
• Macromedia - Authorware Tutorial

Dreamweaver

Dreamweaver is the solution for professional Web site design and production.

Primary use

• Web site authoring
• Interactive Web pages

Primary users

• Web designers
• Web developers

Unique strengths for the learning developer

• Produces 100% HTML-based content
• Delivers interactivity and logic in a browser
• Creates and manages your learning site and assets
Macromedia Dreamweaver is the premier software among Web professionals for building Web sites. The authoring interface is optimized for designing and building the pages that make up the Web. Dreamweaver enables authors to work in a visual page layout environment as well as a code-editing environment and to move seamlessly between the two views. This “round-trip editing” approach gives authors the productivity of a visual design tool and the control of a coding environment.

The Dreamweaver page-based user interface

Since Dreamweaver is a Web authoring product, all of the content a learning author creates is delivered as 100% HTML and JavaScript. HTML delivers learning content to the broadest audience, since anyone with a browser can view this content. Also, HTML content performs well over low-bandwidth connections as long as the page does not contain numerous or large graphics and media files.

Dreamweaver excels in the development of dynamic HTML (DHTML), allowing an author to deliver substantial interactivity and logic within a browser. Macromedia learning extensions, such as the CourseBuilder for Dreamweaver and UltraDev extension and the Learning Site Command, make it easy to create learning content including content presentation, navigation, interactivity, and quizzes complete with student tracking to a back-end system. With these extensions, an author can develop interactive content without any knowledge of JavaScript. Dreamweaver learning extensions are available in the Learning category of the Macromedia Exchange, at www.macromedia.com/exchange.

For anyone delivering Web-based learning, Dreamweaver is an invaluable product for bringing everything together on the Web. It lets developers create a learning site and assemble and manage learning assets. At the page level, Dreamweaver developers can embed rich-media content created in any Macromedia authoring product. At the site level, Dreamweaver developers can define a learning site and then manage site content. Features like file check-in and check-out, copying files to the Web server, and link-checking support the deployment of online courseware by individuals or teams.
Dreamweaver is extremely open and extensible, giving developers tremendous flexibility to extend and customize the platform for their particular needs. Advanced developers can create extensions that encapsulate specialized functionality and make it available to less expert authors. Custom extensions can be added as new menu commands or drag-and-drop objects on the Objects panel. Dreamweaver also provides a utility that lets developers modify the menu system to make customized versions of Dreamweaver for production authors. Finally, Dreamweaver supports Dream templates templates that control which sections of a page are editable.

Limitations

Because Dreamweaver creates pages that are interpreted by a browser, content created in Dreamweaver alone is subject to the limitations of the browser. These limitations are addressed in depth in “Choosing Your Solution.” Developers can overcome browser limitations by enhancing Dreamweaver pages with rich-media content created in Macromedia Flash, Director, or Authorware. Another possible issue for learning development in Dreamweaver is the page-based metaphor of the Web. This metaphor can lead to page-turning applications with limited flexibility of navigation in an application. Good design and appropriate use of embedded rich-media can address this issue. A final limitation of HTML is that the open nature of the source code might allow a savvy user to identify the answers to a quiz. There are a number of ways to address this issue: disabling browser menu options, storing questions and answers in a server-side database, or delivering assessments in the secure environment provided by a player such as Macromedia Flash, Director, or Authorware.

Examples

• MathDork - Interactive math
  www.mathdork.com

• Wehelpkids.com - Reading and mathematics courses
  www.wehelpkids.com/whk/

• 3Com - Small Business Learning Center
  http://learningcenter.3com.com/coursCat.asp
**Dreamweaver UltraDev**

UltraDev is the solution for rapid Web application development.

**Primary use**
- Web-based applications
- Data-driven Web sites

**Primary users**
- Web designers
- Web application builders

**Unique strengths for the learning developer**
- Provides all the strengths of Macromedia Dreamweaver
- Simplifies database connectivity over the Web
- Enables the development of data-driven learning content

Dreamweaver UltraDev provides all the capabilities and strengths of Dreamweaver, plus the ability to easily connect Web pages to server-side databases. Dreamweaver UltraDev facilitates both reading from and writing to external databases using ASP, JSP, or ColdFusion tags. Macromedia learning extensions let you create content with the CourseBuilder for Dreamweaver and UltraDev extension and send the results to a data source defined in Dreamweaver UltraDev.

Just as UltraDev supports the development of data-driven Web sites, it also provides a platform developers can use to create data-driven learning content. Features like LiveData lets developers see their data in the context of the page they are developing, accelerating development and delivering more predictable results.

For learning developers, Macromedia has a version of the Learning Site Command for Dreamweaver UltraDev. This extension lets an author send student results from courses built with Macromedia learning extensions to a back-end system for tracking. The Learning Site Command enables tracking to industry-standard learning management systems (LMS) or to an Access database via ASP middleware files. Other Macromedia learning extensions are available on the Macromedia Exchange as well. These include CourseBuilder for Dreamweaver and UltraDev and others that simplify and accelerate the creation of online courseware.
Limitations
Dreamweaver UltraDev has much the same limitations (and possible solutions) as Dreamweaver. Dreamweaver UltraDev does address one limitation of Dreamweaver by letting application content, such as answers to a quiz, be stored in a database, to prevent users from finding the answers to a quiz.

Example
Royal Roads University - Distance learning
www.cedarlearning.com/

Director Shockwave Studio
Director Shockwave Studio is the solution for developing engaging Internet destinations and powerful multimedia

Primary use
• Multimedia for the Web and CD
• High-impact presentations
• Training and education presentations

Primary users
• Web developers
• Multimedia professionals
• Corporate presentation specialists

Unique strengths for the learning developer
• Allows robust media handling and synchronization
• Provides powerful Lingo scripting
• Enables Shockwave Player delivery over the Web
Director Shockwave Studio is the industry-standard product for creating powerful multimedia content. The application gives the developer the role of the choreographer. As a choreographer, a developer must focus on synchronizing a series of activities over time. The Director interface is a timeline that can contain up to 1000 tracks. Media elements are added to the timeline, and drag-and-drop behaviors and Lingo scripting are used to add interactivity and logic. Media assets and code are organized and maintained in groups called casts.

**The Director timeline-based user interface**

Thanks to its timeline-based interface, Director excels at media handling and synchronization, critical for learning applications with complex simulations. These simulations might address software applications or interactive, 3D models of equipment. Of all Macromedia products, Director provides the broadest and most powerful media support. Besides providing powerful animation capabilities in its own right, Director supports industry-standard formats for all types of media, including text, graphics, animation, audio, and video. Director is the only Macromedia product that provides direct support for true 3D graphics. Support for streaming RealMedia enables developers to integrate existing video assets into learning applications for delivery over the Web.
Director provides a powerful scripting language called Lingo, which gives developers robust programming capabilities and extensive control over media. Lingo programmers can develop behaviors that provide reusable code and simplify many authoring tasks. With extended capabilities such as the Multiuser Server, developers can easily incorporate collaboration and virtual whiteboard features into any learning application.

Finally, content created with Director can be efficiently delivered over the Web as Shockwave content. The Shockwave Player is preinstalled on new PCs and Macintosh computers. Currently, over 200 million users have the Shockwave Player installed, and approximately 200,000 people install it daily. The Shockwave Player delivers the most interactive and rich-media experience possible on the Web.

Limitations

Director is a powerful development environment for learning, but it does not provide beginning instructional developers with extensions or wizards to help build the application structure or learning interactions. To design a learning application, an author should be comfortable using or learning the Lingo scripting language. This means that for learning applications, Director has a somewhat steeper learning curve than other Macromedia products. In the hands of a proficient programmer, Lingo is an asset. To help intermediate developers design learning applications, Macromedia has developed a learning sample movie and documentation, which are available on the Macromedia eLearning Resource Center, www.macromedia.com/learning. Finally, for developers who want to track student data to a learning management system (LMS) or database, coding is required.

Examples

- Hospital for Sick Children in Toronto - Medical training
  www8.ewebcity.com/vickor/Marina/hospitalCD.html
- ExperiencePoint - Business simulations
  www.experiencepoint.com
- OhmZone - Science education
  www.article19.com/shockwave/oz.htm
- ExploreLearning.com - Math and science education
  www.explorelearning.com
Flash

Flash is the professional standard for producing high-impact Web experiences.

Primary uses

• Web site interfaces
• Narrative animations
• Dynamic, Web-based applications

Primary users

• Web designers
• Web developers
• Animators

Unique strengths for the learning developer

• Produces high-impact, low-bandwidth content (vectors)
• Creates sophisticated animations
• Takes advantage of the ubiquity of the Macromedia Flash Player
Macromedia Flash is the premier software for creating powerful Web experiences. It enables authors to build attractive and effective Web interfaces and applications, beautiful graphics, and engaging narrative animations. The Macromedia Flash user interface has a timeline that can contain multiple layers.

The timeline metaphor excels at letting an author manipulate and synchronize media elements over time. You can add interactivity, branching, and logic by using the Macromedia Flash ActionScript language.

Macromedia Flash has grown increasingly popular as a product for creating e-learning applications. The first reason for this is the very lightweight yet high-impact vector file format produced by Macromedia Flash. Vector-based files tend to be much smaller than files that store information pixel-by-pixel, such as bitmaps. Consequently, vector files perform well over low-bandwidth connections that are common for most users, as well as for many professionals who are dialing in to a company intranet. Despite the small file size, the Flash file format produces beautiful graphics and animations that have the additional advantage of being resolution-independent. The Macromedia Flash Player not only supports text, graphics, and sophisticated animation but also can include streaming MP3 audio. This media support combined with the scripting capabilities of ActionScript lets developers create content that delivers a more compelling user experience than traditional technologies.
A second reason that Macromedia Flash is a powerful tool for learning applications is that it enables you to create sophisticated graphics and animations that are extremely valuable for illustrating facts, concepts, and procedures. Simple animations are useful to capture and direct a learner’s attention. The more advanced features, such as gradients, alpha channels, and masks, let you create content that is beautiful and captivating.

Finally, Macromedia Flash has become popular thanks to the ubiquity of the Macromedia Flash Player. The Flash player is now preinstalled in all major operating systems and browsers, and provides powerful and consistent delivery of text, graphics, animation, and audio across the broadest range of systems and devices. Learning developers are increasingly taking advantage of these rich capabilities and the availability of the Macromedia Flash Player to deliver e-learning applications to consumers, students, partners, and employees.

Limitations

Macromedia Flash has some of the same limitations as Director. Both products have a timeline-based authoring metaphor and rely on scripting to deliver interactivity, branching, and logic. Macromedia Flash does have a collection of learning interaction Smart Clips (accessed by choosing Window > Common Libraries > Learning Interactions), which simplify the process of creating common question types. Learning extensions are also available on the Macromedia Exchange, www.macromedia.com/exchange, that will assist you with creating a page-turning framework and a quiz. Macromedia Flash supports a broad range of rich media, but it does not provide support for digital video or true 3D graphics.

Examples

• Corpedia - Corporate training
  www.corpedia.com/welcome/demo.asp
• KnowledgeNet - Business and IT Training
  www.knowledgenet.com
• Fraboom - K-8 Education
  www.fraboom.com/
• Rhythm Media
  www.rhythm.com.au
Generator

Generator is the server solution for automating and personalizing your Web site graphics.

Primary uses

• Dynamic, graphical Web applications (including news, information, financial, and learning applications)
• Automating Flash workflow

Primary users

• Web developers
• Web designers

Unique strengths for the learning developer

• Enables the development of data-driven learning content
• Allows the creation of personalized learning content
• Delivers content with the Macromedia Flash Player

Macromedia Generator is a powerful server product that can be used to produce dynamic, data-driven learning content that is delivered with the Macromedia Flash Player. Generator draws upon information and media assets stored in a database and composites, produces, and delivers Web content on the fly. While Generator is capable of producing output in a number of different file formats, Macromedia Flash files are the most valuable output for a learning developer.
Macromedia Flash is the authoring environment for creating Macromedia Generator elements and templates. Generator templates separate design from content so that content changes that are made in the database are automatically reflected in the Web application.

A Generator template within Macromedia Flash

The combination of Macromedia Flash and Generator is an extremely powerful platform for building a data-driven learning system. Generator supports the creation of data-driven learning content that can be generated dynamically, or generated offline and then posted to the Web. The ability of Generator to dynamically produce content lets you create personalized learning content that adapts to the learner’s style, prior knowledge, or performance in a course. Finally, because Generator can produce the Macromedia Flash file format, learning developers can take advantage of the broad distribution of the Macromedia Flash Player to reach users with engaging and dynamic online courseware.

Limitations

Macromedia Generator extends the capabilities of Macromedia Flash. The limitations to be aware of with Generator are those that apply to Flash.
Examples

• SuddenlySmart - Corporate training
  www.suddenlysmart.com/
• Reindeer.com - Higher education courses
  www.reindeer.com/
• Royal Roads University - Distance learning
  www.cedarlearning.com/courses/

Macromedia design software

Besides authoring software, Macromedia provides products for designing graphics content, including Fireworks for creating graphics and FreeHand for designing illustrations. Both products integrate tightly with Macromedia authoring products to provide powerful content creation capabilities and optimized workflow across products.

Fireworks

Fireworks is the solution for professional Web graphics design and production.

Primary uses

• Designing, editing, and animating Web graphics
• File optimization

Primary users

• Web designers
• Web developers
• Multimedia professionals

Unique strengths for the learning developer

• Uses a flexible graphics editing environment combining vector and bitmap tools
• Provides industry-leading file optimization
• Provides a seamless workflow with Macromedia authoring applications
Fireworks provides a powerful solution for creating graphics for your learning applications. Tight product integration between Fireworks and other Macromedia authoring software products ensures that you’ll be able to take advantage of the many Fireworks features developed for the designer producing content for screen-based delivery.

The Fireworks user interface

Fireworks mixes vectors and bitmaps in a single development environment, letting you quickly edit and update graphics as you move through the production process. Features such as Live Effects, Live Animations, and Text transformations mean that in Fireworks everything is editable all the time.

When producing graphics for delivery over the Internet, a high priority for designers is to optimize a file for the smallest file size while maintaining the quality and integrity of the image. Features such as Export Preview in the Workspace, Selective JPG compression, and 8-bit alpha transparency PNG Export provide users with the best optimization capabilities available.

Integration with the other Macromedia authoring applications makes it easy to work on graphics and quickly integrate them into your projects. Round-trip Table Editing from Dreamweaver and UltraDev, Launch and Edit graphics from Flash, and the Fireworks Import Xtra for Director are just a few examples of the many features that provide a seamless workflow for the e-learning professional.
**FreeHand**

FreeHand is the multi-publishing solution for the graphic design professional.

**Primary use**

- Professional illustration and graphic design
- Project layout and storyboarding

**Primary Users**

- Illustrators and graphic designers
- Web designers and developers
- News and publication agencies

**Unique strengths for the learning developer**

- Provides a seamless workflow with Macromedia authoring software
- Preserves layer information from FreeHand to Flash
- Apply Flash actions directly within FreeHand
For developers who need to create illustrations and graphics for use in their learning applications, Macromedia FreeHand provides a powerful design tool. FreeHand also lets you tap into large commercial libraries of vector-based clip art. Clip art images can be edited and enhanced within FreeHand to produce the right visual element. Advanced features like gradients, alpha-channels, and masks let you create content that is captivating and effective. Illustrations and graphics created or enhanced in FreeHand can be exported to a variety of bitmap image formats such as BMP or JPEG for use within any Macromedia authoring software.

The FreeHand user interface

Tight cross-product integration lets you directly import content created in FreeHand into Macromedia Flash. All symbol and layer information is preserved. Once in Macromedia Flash, the content can be animated using the Macromedia Flash timeline and made interactive through the use of ActionScript. For the designer, FreeHand includes many productivity features such as Master Pages for managing very large projects, and the ability to apply and test Flash Navigation actions directly within FreeHand. Whether you use FreeHand to produce visual content for subsequent authoring in Macromedia Flash or import FreeHand content into other Macromedia authoring software, FreeHand provides a valuable addition to the learning developer’s tool kit.
Integrated products

No one product meets the demands of different applications and different authors equally well. In most cases, you will need to use several Macromedia products. Fortunately, there are many ways in which Macromedia tools work well together during both authoring and delivery. For example, you can preview Shockwave content embedded in a Dreamweaver Web page directly within the authoring environment. Or you can create a powerful animation in Macromedia Flash that you can import and deliver within a course built with Authorware. Or you can combine Dreamweaver UltraDev and a ColdFusion server to deliver data-driven learning applications.

In the learning industry, the trend is away from large, monolithic courses toward smaller, more granular learning objects. A learning object can be anything from a single animation or video file to a short lesson on a specific topic. Ideally, this object has descriptive metadata associated with it and is stored in a database. Even without a database, smaller learning objects can more easily be reassembled and reused for other learning tasks at a later date. This strategy can dramatically decrease the time and cost required to develop courseware. Learning objects also provide the basis for personalized learning where customized content is dynamically served based on the needs of the learner. As learning objects become smaller, it makes sense to create each one with the software that most effectively and efficiently addresses the specific development task.

Whatever your requirements, Macromedia has the products you need to realize your instructional and design objectives. The challenge is determining what mix of products is right for you. We hope this introduction to Macromedia products gives you the information you need to make that decision. If you need more guidance, you can download a Macromedia document, “Choosing Your Solution.” This chapter provides additional detail on evaluating Macromedia products for creating e-learning. It is available on the Macromedia eLearning Resource Center, www.macromedia.com/learning.
Learning resources

Macromedia provides extensive informational and support resources on our Web site. The Macromedia eLearning Resource Center is a focal point for e-learning information, and can be found at www.macromedia.com/learning. It provides resources, downloads, links, and more for the e-learning developer and manager.

Trial software

You may download and test drive free 30-day trial versions of Macromedia software.


Online training

To help you get up to speed with Macromedia products, Macromedia offers online courseware on all Macromedia products as well as on Web tools and technologies.

www.macromedia.com/university.

Product information

Visit the Macromedia Web site for product information including feature tours, support, complementary products, system requirements, tutorials, and more.

www.macromedia.com/products

Macromedia exchange

The Macromedia Exchange provides a repository of free extensions for Macromedia Dreamweaver, Dreamweaver UltraDev, Fireworks, and Flash.

www.macromedia.com/exchange

Accessibility

Information on authoring accessible content is available on the Macromedia Web site.

www.macromedia.com/accessibility/
CHAPTER 2
Choosing Your Solution

Introduction
For training professionals, educators, or subject matter experts, choosing a solution to create your e-learning application can be a daunting task. While you might have a clear idea of what you want to deliver, selecting the right tools and technologies to get the job done may not be so obvious. There are many authoring products to choose from, and the technology often seems complex. The goal of this chapter is to help you understand the choices available from Macromedia and decide which product or combination of products is right for you.

Macromedia products used for e-learning
Macromedia has a range of products capable of producing engaging and effective e-learning applications. These products include design tools and authoring software, as well as powerful server technologies. This chapter focuses on Macromedia authoring products.

Macromedia design software includes the following tools:
• Fireworks
• FreeHand

Macromedia authoring software for learning includes these applications:
• Authorware
• Director
• Dreamweaver
• Dreamweaver UltraDev
• Flash
Macromedia server solutions include the following software:

- ColdFusion
- Generator
- JRun

You can use Macromedia products to produce everything from simple text and graphics tutorials delivered on the Web to powerful data-driven learning systems. They are used by a range of developers, from the novice author to the advanced developer. Instructional developers have traditionally chosen Authorware and Director to create large, formal learning applications where instructional design is a primary focus. For the developer and programmer community who create smaller, more informal instructional content, Web authoring products such as Macromedia Flash and Dreamweaver, and Macromedia learning extensions, provide the preferred authoring solution. For large organizations that want to build data-driven systems and let subject matter experts contribute content via templates, Macromedia's server solutions are the products of choice.

The challenge for the learning developer or training manager is to become familiar with the capabilities of each of these products. How are they different? What are their strengths? What are their limitations? How do they work together? The answers to these questions will help you determine which product or combination of products is the best choice for your requirements.

When deciding which Macromedia software is best for your e-learning application, ask yourself the following six questions about your project and your team:

- Where are you delivering your e-learning?
- What kinds of media do you intend to use?
- What level of interactivity do you want?
- How much data tracking do you need?
- How much content will you produce and maintain?
- What is your technical skill level?

The answer to one of these questions may point so strongly to a specific Macromedia tool that you will not need to answer the rest. Or, you may need to consider the answers to all the questions before you can select the best tool for your needs.
Choosing Your Solution

The following table compares Macromedia authoring products in these six areas, which are important for learning developers.

<table>
<thead>
<tr>
<th>Product</th>
<th>Delivery platforms</th>
<th>Rich-media</th>
<th>Interactivity</th>
<th>Data-tracking capabilities</th>
<th>Data-driven capabilities</th>
<th>Author skill requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macromedia Authorware</td>
<td>CD LAN/WAN Intranet</td>
<td>Yes</td>
<td>Advanced</td>
<td>Advanced</td>
<td>Basic to intermediate</td>
<td>Low to moderate</td>
</tr>
<tr>
<td>Macromedia Dreamweaver</td>
<td>Web Intranet</td>
<td>No</td>
<td>Basic</td>
<td>Basic</td>
<td>Basic</td>
<td>Low</td>
</tr>
<tr>
<td>Macromedia Dreamweaver UltraDev</td>
<td>Web Intranet</td>
<td>No</td>
<td>Basic</td>
<td>Intermediate to advanced</td>
<td>Advanced</td>
<td>Moderate to high</td>
</tr>
<tr>
<td>Macromedia Director</td>
<td>CD LAN/WAN Web Intranet</td>
<td>Yes</td>
<td>Advanced</td>
<td>Intermediate</td>
<td>Basic to intermediate</td>
<td>Moderate to high</td>
</tr>
<tr>
<td>Macromedia Flash</td>
<td>Web Intranet Devices</td>
<td>Yes</td>
<td>Intermediate to advanced</td>
<td>Intermediate</td>
<td>Advanced</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

While this summary chart is useful, it cannot summarize all of the information required to answer these six questions. The remainder of this chapter examines these six questions in greater detail and gives you the information you need to answer each one of them. Whether you are a new user trying to decide which Macromedia products to purchase, or an existing customer evaluating which products to use for a new project, you will benefit from taking the time to evaluate your options. In many cases, the best solution is a combination of products.

**Using products together**

Most learning developers use more than one product to address the range of learning applications they need to create. This is because no one product does it all. Each product has unique strengths, ranging from rich media to programmability and interactivity to data connectivity. The best results often come from using more than one product together. For authors who want to deliver learning applications on the Web, a Web authoring application such as Dreamweaver is an indispensable tool. It provides the software with which to design your learning site. It also provides a hub in which you can assemble and manage instructional assets created in Dreamweaver or in rich-media tools such as Macromedia Authorware, Director, and Flash.
Here are a few examples of how you can combine content created in multiple Macromedia products to deliver engaging instructional content:

- Import scalable technical diagrams designed in Flash into an online training and reference system created in Authorware
- Integrate Flash animations with smaller file sizes into a Web educational application designed in Director
- Design Web pages in Dreamweaver and then embed a software simulation created in Authorware or a 3D simulation created in Director
- Create templates in Macromedia Flash and then use Generator to deliver data-driven, graphical content
- Track student participation and progress through interactive learning applications built with Dreamweaver UltraDev

As you can see, there are many different ways to combine Macromedia products to deliver great e-learning applications. We hope this chapter clarifies the capabilities and strengths of each Macromedia product and helps you choose the solution that is right for you.

**How are you delivering your e-learning?**

Where and how you plan to deliver your e-learning is a critical first question, which will quickly narrow the choices for authoring software. To answer this question you need to identify the following factors:

- Delivery method—Internet, intranet, or CD delivery
- Bandwidth constraints
- Which browsers and operating systems your course will support
- Required plug-ins or players

Will you deliver your course over the Internet to a broad range of users? Or will you deliver courseware to an internal audience over a corporate intranet? Perhaps you need to deliver on CD for employees who will train at home or while traveling. Many projects require delivery to more than one of these platforms. Where you deliver your training affects which software options are available to you.

Internet- and intranet-based delivery of courseware differ in two important ways: first, in the amount of bandwidth that is available, and second, in the level of control you have over the users’ system configurations. When developing for the Internet, you need to accommodate a broad and diverse user audience, many of whom have low-bandwidth dial-up connections. Furthermore, you won’t know how these users’ systems are configured, nor can you control this.
In developing content for the Internet or an intranet, you will need to consider many configuration details. For example, what operating systems will you support? What browsers and versions are required? Do your learners have the required plug-ins installed? The answers to these questions often differ if you are designing for the Internet versus an intranet.

No matter how you plan to deploy your e-learning, evaluating and specifying your course delivery environment before you choose your authoring tool enables you to make wise decisions about which software will deliver your content most successfully.

**Designing for the Internet**

When you design courseware for the Internet, you need to select technologies that perform well over low-bandwidth connections. In fact, it is a wise idea to design your courseware to perform acceptably over the lowest connection speed you plan to support. For example, you may need to deliver training to field personnel who have 33 Kbps modems. For these users, it is important to deliver content that is easy to access and view, which means avoiding unnecessary downloads and complicated setup procedures. To do this, you should rely on broadly available technologies, such as HTML, Macromedia Flash, and XML.

Macromedia Dreamweaver and Dreamweaver UltraDev produce HTML, the most commonly used language of the Web. The advantage of using HTML is that it can be viewed in any browser. The disadvantage is that simply creating content in HTML does not guarantee that your course will perform well over the Internet. Performance depends upon the design of your page, how many layers you use, and the number and size of embedded graphics. HTML alone also has significant limitations when it comes to interactivity and rich-media support. For example, many interactions such as dragging and dropping are possible only in the newer browsers, which support layers. The best way to overcome these limitations is to combine HTML pages with rich-media elements created with products like Macromedia Flash and Director.

Flash overcomes many of the limitations of HTML while still providing delivery that is “Web-native.” Flash produces a vector-based SWF file that is extremely compact and performs well over low bandwidth. The Macromedia Flash Player is now preinstalled in major operating systems and browsers, allowing over 96% of all visitors on the Web to view Flash content. Macromedia Flash is the most ubiquitous player on the Web, with over 350 million players installed to date. When a download is required, the Macromedia Flash Player is only about 200K and can be downloaded in less than a minute over a 56-Kbps connection.
Macromedia Director produces Shockwave content for delivery over the Web. The Macromedia Shockwave Player is also widely distributed. Shockwave is installed on over 200 million desktops to date, allowing over 60% of all Web users to view Shockwave content. For those who don't have the player, it is easily installed from the Macromedia Web site or redistributed from your intranet. The Shockwave player is 3.4 MB (megabytes) and requires approximately 8 minutes to download over a 56-Kbps modem. The Shockwave file format is not vector-based like that of Macromedia Flash, but it does provide streaming, which allows rich-media content to perform well over the Web. Director can embed and control native Flash files. The strength of Shockwave is that it provides the richest, most interactive experience possible on the Web.

Authorware is the least common choice for deploying courses primarily over the Internet, because the Authorware Web Player is not preinstalled on personal computers or in browsers. Since the Authorware Web Player is 4.4 MB, downloading it can be time-consuming for users with low-speed connections. Authorware learning applications are typically deployed to organization intranets, where bandwidth is not an issue and where browsers are sometimes preconfigured. Macromedia provides a one-button installation solution for the Authorware Web Player called AutoInstall, and organizations can host and deploy the player from their own intranet.

**Designing for an intranet**

When you design courses for an intranet, you typically have a smaller audience and a better-known delivery environment. With an intranet, learners usually connect to the network at much faster speeds than they would over the Internet, and you will know much more about the system configurations you need to support. This lets designers take advantage of a broader range of technology and employ more rich-media content. If you deploy your course on an intranet, you can choose any Macromedia authoring product subject to your organization's policies regarding players.

As with courseware you deliver over the Internet, you should identify the lowest bandwidth you need to support and design for that bandwidth. Also, find out if your organization has policies or processes in place regarding installing and supporting players. For example, some organizations prohibit installing players on an intranet for security reasons. Others have a formal process for approving the use of players and may even preconfigure or manage desktop configurations centrally. Learn about the possibilities and limitations within your organization before you make your decision.

Another advantage to delivering on an intranet is that many organizations have specified a standard browser. Knowing the browser and version that you must support can dramatically simplify your job. You will know in advance what players and browser capabilities you have to work with, and your testing burden will be much lighter.
Choosing Your Solution

Setting minimum system requirements

Whether you are deploying to the Internet or to an intranet, you can establish minimum system requirements for your learning applications. These requirements can include browser make and version, operating system, players, connection speed, and amount of memory. Where appropriate, system requirements can be combined with a setup and testing page where users can download required components and test the readiness of their computer. This approach works well as long as your requirements are reasonable, the installation steps are not too complex, and end users can get help if they need it.

Designing for CD and DVD

Many organizations still prefer or need to deploy training on CD or DVD. CD and DVD provide portability and the ability to store large amounts of rich media such as audio and video. If media-heavy content cannot be delivered over your target network, you can deliver it using a “hybrid” solution (where part of the content is online and part is on the CD). While all Macromedia authoring products create content that can be delivered on CD, Authorware and Director take greatest advantage of this media. Both support the broadest range of rich-media types and have many features useful for creating courses that run locally rather than over the Web. For example, Authorware has the ability to read and write to local databases or store data in flat files using built-in file input-output functions. Flash, although primarily used for creating Web-based content, can save an application as an executable file for local delivery on CD. Finally, though it is not the best use of the media, a Web site built in Dreamweaver or UltraDev can be published to CD and viewed with a browser.

Designing for mobile devices

Organizations today are planning for future deployment options, which may include mobile devices. A broad range of devices support the delivery of Web-native content. Macromedia Flash, Dreamweaver, and UltraDev content can be delivered on Internet-enabled devices such as AOL TV, 3Com Audrey, Microsoft WebTV, and MSN Web Companion. The Macromedia Flash Player enables the delivery of learning content on devices running the Microsoft Pocket PC operating system, including the Compaq iPAQ, Casio Cassiopeia, and Hewlett-Packard Jornada. Current Pocket PC devices provide 16-bit color, built-in audio capabilities, and up to 206 MHz processing power.

Macromedia provides a Macromedia Flash Authoring Kit for Pocket PC complete with authoring guidelines, documentation, and examples. The kit is available on the Macromedia Web site, at www.macromedia.com/software/flashplayer/pocketpc/authoring/.
Other Web-compatible wireless devices include pagers, cellular phones, and other personal devices that support a browser. A WML extension for Dreamweaver and UltraDev lets developers target handsets that support the Wireless Application Protocol (WAP). This toolkit is available online in the Macromedia Exchange for Dreamweaver in the category “Browsers,” at www.macromedia.com/exchange.

**Designing for bandwidth**

Keep in mind that application media and design heavily influence performance. An experienced designer can produce content that performs well at low bandwidths with any Macromedia product. An unskilled author can produce applications that are slow regardless of the authoring tool. Nonetheless, some Macromedia products provide features and technology that make it easier to design content for low bandwidth. Our goal is to provide you with guidelines and to highlight the relative capabilities of Macromedia products. For a more detailed discussion of how to develop for low bandwidth with all of the Macromedia authoring products, see “Developing for Low Bandwidth” on page 131 in the Macromedia guide, *Getting Started with E-learning* at www.macromedia.com/resources/learning.

Comparing bandwidth constraints

The following table compares the performance of content created with each Macromedia authoring tool at different bandwidths.

- **High bandwidth** is defined as LAN, T1, DSL, and cable modems with Internet connection speeds of 128 Kbps or faster.
- **Medium bandwidth** refers to modems with Internet connection speeds of 56 Kbps modems to 128 Kbps ISDN.
- **Low bandwidth** refers to modems with connections of less than 56 Kbps.
## Comparing bandwidth constraints

<table>
<thead>
<tr>
<th>Product</th>
<th>Bandwidth</th>
<th>Tool suitability</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low → High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authorware</td>
<td>High</td>
<td>★★★★★</td>
<td>Authorware works well over high- and medium-bandwidth connections. It is possible to use Authorware to design for low bandwidth, but a good result depends on experience and developer skills. The primary constraint with low-bandwidth delivery is a relatively large player that has to be downloaded from the Macromedia Web site or redistributed from an internal or external site.</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>★★★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>★ ★ ★ ★</td>
<td></td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>High</td>
<td>★★★★</td>
<td>HTML files with no embedded rich media (e.g., Flash, Shockwave, QuickTime) perform reasonably well over all bandwidths. This is true because HTML files that include text and modest graphics are relatively small. Poor Web page design can lead to slow performance.</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>★★★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>★★★★</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td>High</td>
<td>★★★★★</td>
<td>Director works well over high- and medium-bandwidth connections. The Shockwave player is already installed in a majority of systems. Where it is not, the player is a reasonable size and can be downloaded from the Macromedia Web site or redistributed from an internal or external site.</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>★★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>★ ★ ★ ★</td>
<td></td>
</tr>
<tr>
<td>Flash</td>
<td>High</td>
<td>★★★★★</td>
<td>Flash has the ability to perform well at all bandwidths. The Flash vector file format helps keep application size small and a bandwidth profiler helps authors test performance at their target users’ connection speeds.</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>★★★★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>★★★★</td>
<td></td>
</tr>
</tbody>
</table>
Web-native versus player-based delivery

When evaluating delivery technologies, decide whether you will rely on a player (such as the Macromedia Flash Player) to deliver your learning content. Many products used to deliver e-learning applications require the use of a player (sometimes called a plug-in), which is an auxiliary application that extends the capabilities of the browser. For example, installing the RealMedia player lets users receive streaming video and audio over the Web. Macromedia Authorware, Director, and Flash all use players to deliver rich, interactive content over the Web. Without players, a browser is capable of displaying HTML pages that support text, graphics, basic animations, and an intermediate level of interactivity.

If you decide to create e-learning that does not require a player, your authoring choice is simple: Macromedia Dreamweaver or Dreamweaver UltraDev, both of which produce Web sites delivered in HTML. Macromedia provides learning extensions for the Dreamweaver platform that simplify and accelerate the process of creating e-learning content and sites. These include the CourseBuilder extension for Dreamweaver and UltraDev and the Learning Site Command. The main advantage of this approach is that your content is accessible to the broadest possible audience: anyone with a Web browser.

There are however, several disadvantages to relying exclusively on HTML for delivering your content:

- A browser alone does not support rich media, such as audio, video, or sophisticated animations. This constrains the media content you can use in your courseware.
- Creating sophisticated interactivity with HTML and JavaScript requires programming expertise.
- Since HTML source code is viewable by the user, some organizations are concerned about the security of assessments.
- Major browsers do not always interpret HTML and JavaScript in the same way. In some instances, you may need to develop interactions that are specific to each browser, doubling your development and testing effort.

Advantages of using players

Creating your e-learning with a product that requires a player offers the following advantages:

- Players support many more types of media than browsers, and can support streaming of rich media such as audio and video.
- Players support a broader range of interactivity and more robust scripting capabilities than you will find in a browser.
- Players increase the fidelity of an application across diverse browsers, versions, and operating systems.
Choosing Your Solution

Having to test only one playback environment reduces the testing required to fully assure the quality of a finished application.

Players provide more security than HTML- and JavaScript-based courseware, where code can easily be copied and where in some situations savvy users may be able to identify right and wrong answers for a quiz.

Two disadvantages of using players to develop your e-learning application are that some organizations may restrict the download and installation of players, and that users may need help downloading and installing players in their browsers. Fortunately, the Macromedia Flash and Shockwave players are preinstalled in a large percentage of user systems. As of March 2001, the Flash player is present in approximately 96% of browsers and the Shockwave Player is present in 60% of browsers.

To assist with player installation, Dreamweaver and UltraDev include a Check Plugin behavior you can use to check whether the user has a specific player installed. If the user doesn't have the required player, you can send the user to a Web page with instructions on how to install it. The code necessary for including this test in your course is available for free on the Macromedia Web site. Macromedia Flash and Director provide HTML templates to which finished projects can be published. Each has an HTML template with the JavaScript required to test whether a user has the right player installed.

The Macromedia Flash, Shockwave, and Authorware players are all available as free downloads from the Macromedia Web site. Information on player distribution and details on how to license and redistribute any Macromedia player is available on the Macromedia Web site. You will find additional information online.

• For Macromedia player downloads:
  www.macromedia.com/downloads/
• For Macromedia Flash and Shockwave player licensing:
  www.macromedia.com/support/shockwave/info/licensing/
• For Macromedia Authorware Web Player licensing:
  www.macromedia.com/support/shockwave/info/licensing/authorware/

What kinds of media will you use?

To answer the second question, you need to identify the following factors:

• Types of media you want to use—graphics, animation, audio, video
• Instructional requirements for media
• Budget for developing or acquiring media
Which media types are critical for your intended applications? What kinds of media would you like to include? Media use affects not only how you design your learning applications but also which authoring tool you need. Each Macromedia product supports a slightly different set of media types. Each product has different strengths when it comes to creating, importing, and manipulating media.

Begin by considering your training content. Some subjects require the use of specific media types. For example, an application providing instruction for how to speak a foreign language should include audio. Science courses often benefit from animations that illustrate concepts that are difficult to explain or can’t be viewed directly, such as a chemical reaction or the performance of a membrane. Or perhaps you have extensive video assets that you would like to repurpose, in which case your authoring software must support video. Once you have an idea about what media you expect to use, you can evaluate how well each product meets your requirements.

**Rich-media tools**

Macromedia Authorware and Director support the broadest range of media of all the Macromedia products, including text, graphics, animation, audio, and video. In addition, Director has unique strengths: support for interactive 3D content and the ability to integrate streaming RealAudio and RealVideo. Support for 3D content enables Director to deliver powerful training simulations that re-create environments such as an assembly line or equipment such as an airplane. Support for streaming RealMedia extends the full rich-media experience available today on CD or DVD to the Web. Macromedia Flash also enables applications that include text, graphics, animation, and audio, but not video or true 3D graphics.

Macromedia Generator is a server solution that composites, produces, and delivers visual content on the fly. Macromedia Flash is the authoring environment for creating Generator elements and templates. Generator adds personalization, dynamic graphics, and automation to Macromedia Flash Web applications. Generator dynamically outputs unique Flash movies, as well as GIFs, animated GIFs, JPGs, PNGs, image maps, QuickTime movies, and Flash projectors (EXE).

Dreamweaver alone has no direct support for rich media such as sophisticated animations, rich graphics, audio, or video. The Dreamweaver target delivery environment is a basic browser that has limited support for rich media. If you are willing to require a player, you can embed Macromedia Flash, Shockwave, or Authorware content into a Dreamweaver Web page to achieve a more media-rich experience. In this case, Dreamweaver is a powerful tool for assembling existing multimedia content on a page, or into a coherent site. It also provides powerful group authoring and site management capabilities such as check-in/check-out of assets, design notes, link checking, search and replace, and more.

Comparing media support
Choosing Your Solution

The following table lists which media types each Macromedia product either imports or creates internally. More information on media support for each product is available in the product home pages on the Macromedia Web site.

<table>
<thead>
<tr>
<th>Product</th>
<th>Imports</th>
<th>Creates</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorware</td>
<td>Text</td>
<td>Text</td>
<td>Authorware supports a broad range of all types of media as well as creates basic shapes and simple cell and path-based animations.</td>
</tr>
<tr>
<td></td>
<td>Graphics</td>
<td>Shapes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Animation</td>
<td>Animations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Audio</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Video</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dreamweaver and UltraDev</td>
<td>Text</td>
<td>Text</td>
<td>Dreamweaver and UltraDev create text and Flash-based text and basic DHTML animations. Dreamweaver and UltraDev can also embed any media for which a Web player exists. The Dreamweaver Fireworks Studio and the UltraDev Fireworks Studio come with Fireworks for graphics creation, optimization, and manipulation.</td>
</tr>
<tr>
<td></td>
<td>Graphics</td>
<td>Graphics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Animation</td>
<td>Animations</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td>Text</td>
<td>Text</td>
<td>Director supports the broadest range of all types of media, including 3D graphics, streaming, QuickTime, and RealMedia. Director creates basic shapes and powerful animations. Director Shockwave Internet Studio comes with Fireworks for graphics creation, optimization, and manipulation.</td>
</tr>
<tr>
<td></td>
<td>Graphics</td>
<td>Shapes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Animation</td>
<td>Animations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Audio</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Video</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash</td>
<td>Text</td>
<td>Text</td>
<td>Macromedia Flash imports key graphics and audio formats. The product also includes strong drawing tools and can create powerful animations. A Macromedia Flash movie can be saved in a variety of formats, including SWF and QuickTime. The Flash FreeHand Studio comes with FreeHand.</td>
</tr>
<tr>
<td></td>
<td>Graphics</td>
<td>Graphics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Animations</td>
<td>Animations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Audio</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Video</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Keep in mind that the media you use affects the amount of bandwidth your course will require. For information on how to optimize content created in each one of Macromedia’s products, see “Developing for Low Bandwidth” on page 131” in the Macromedia guide, Getting Started with E-learning.

What is the level of interactivity?

To answer the third question, you need to identify the following factors:

• Level of interactivity—how often users do something
• Types of interactions—from simple page turning to complex simulations
You can create e-learning applications ranging from simple tutorials to sophisticated applications that simulate anything from desktop applications to an airplane flight deck. The instructional requirements and development budget of each application require different types and levels of interactivity.

While all Macromedia products support interactivity, the kinds of interactions that are possible and the ease with which they are created differ among products. For purposes of evaluating authoring software, the level of interactivity found in learning applications can be characterized as one of three kinds: basic, intermediate, or advanced.

**Basic interactivity**

You can use any Macromedia product to create e-learning with basic interactivity. Applications with basic interactivity include linear presentations, online reference material, and tutorial “page turners.” Most courses include at least some content with this level of interactivity.

**Intermediate interactivity**

Applications with intermediate interactivity include features such as nonlinear navigation and some form of assessment. Users can select a path through a lesson. Assessment might occur within the instruction or quiz, using standard question types, such as true/false, text entry, multiple-choice, and matching. Users receive feedback based on their answers.

Courseware that provides an intermediate level of interactivity includes a greater number and more types of user interactions. Examples of intermediate interactivity are buttons, hypertext, text entry, hot spots, hot objects, and menus. These interactions are combined with logic and conditional branching to create an interactive, instructional experience. Some examples of intermediate activity are new product training, sales training, and educational software.

**Advanced interactivity**

Advanced interactivity depends not only on a rich array of the interactions listed above, but also on using sophisticated logic, conditional branching, and more extensive tracking of user activity. Each interaction might have randomly generated answer options and custom feedback for each answer. Users may be given multiple tries to answer a question, with each try providing different kinds of feedback.

Student performance in different parts of a course, such as on a pre-test or preceding lesson, might affect the content presented in a current lesson. This information could be used to control navigation options and to customize information and feedback that is presented. For example, a course might track what questions a user has seen in order to present new or more difficult content as the user progresses.
Choosing Your Solution

Simulating the control panel of a printing press and completing a multi-step task in a software application are examples of advanced interactivity. These simulations immerse the user in a realistic experience that closely matches the actual environment. Options and results in a simulation may depend upon actions a student has taken in the previous steps of a procedure.

**Support for interactivity in Macromedia applications**

All Macromedia authoring products support the development of applications with basic and intermediate interactivity. Macromedia Authorware, Director, and Flash support the development of applications with advanced interactivity. Dreamweaver is not recommended for applications that require advanced interactivity, because developers are constrained by the limitations of HTML. Fortunately, it’s easy to enhance a Web site built in Dreamweaver with interactive and rich-media elements created in Macromedia Authorware, Director, and Flash. Advanced developers have also used JavaScript to add interactivity.

While some Macromedia products can accomplish similar results with regards to interactivity, they differ in the ease and speed with which developers can build certain types of interactions. If you know in advance that your application will require a lot or a particular type of interactivity, such as text manipulation, dragging and dropping, or keyboard-based events, find out how this is accomplished with the software products you are considering. While a talented programmer can accomplish almost anything with enough time and effort, you want to select the authoring product that makes designing your application as fast and easy as possible.

To assist learning developers, Macromedia has developed a series of learning extensions and samples for Macromedia Dreamweaver, Dreamweaver UltraDev, Flash, and Director. These extensions provide prebuilt elements that are commonly found in basic learning applications, such as navigation, interactions, quizzes, and student tracking. Learning extensions are available as free downloads from the Macromedia Web site and the Macromedia Exchange www.macromedia.com/exchange. There are no learning extensions for Authorware since it already contains extensive learning features.

While all Macromedia software lets developers create engaging, interactive content, two products have specific limitations that are worth knowing about. Macromedia Dreamweaver does not provide full control over keyboard-based interactions. For example, some applications require the use of special keys such as Function or Control keys or keystroke combinations. Support for this kind of interactivity can be important for developing software simulations that require users to interact with the keyboard or open context menus. Macromedia Authorware, Director, and Flash all provide excellent control over capturing and responding to user keystrokes.

The other limitation that you should be aware of is that the Macromedia Flash Player does not support a right-click mouse event. This interaction is used by some Windows applications to display a context menu.
Comparing interactivity support

The following table rates the capability of Macromedia products to provide interactivity for e-learning applications. While this table addresses what interactivity is possible with each product, it does not address whether it is easy or fast to create. Information on each product’s ease of use for creating e-learning is covered later in this chapter.

<table>
<thead>
<tr>
<th>Product</th>
<th>Interactivity level</th>
<th>Interactivity capabilities Low → High</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorware</td>
<td>Basic</td>
<td>★★★★★</td>
<td>Authorware supports rich interactivity and is capable of addressing everything from basic courseware to software and hardware simulations.</td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>★★★★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★★☆</td>
<td></td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>Basic</td>
<td>★★★★★</td>
<td>Dreamweaver supports moderate interactivity. The CourseBuilder extension for Dreamweaver and UltraDev lets you develop interactivity and logic without writing JavaScript. Dreamweaver does not provide good support for keyboard-based interactions useful for software simulations.</td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>★★★★☆</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★★☆</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td>Basic</td>
<td>★★★★★</td>
<td>Director supports very rich interactivity and is capable of addressing any application requirement in this area. Director's ability to create interactive, 3D content is unique.</td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>★★★★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★★★</td>
<td></td>
</tr>
<tr>
<td>Flash</td>
<td>Basic</td>
<td>★★★★★</td>
<td>Flash supports rich interactivity and is capable of addressing most application requirements. Learning extensions simplify creating some common interactions.</td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>★★★★☆</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★★☆</td>
<td></td>
</tr>
</tbody>
</table>

When evaluating authoring software, define the highest level of interactivity your course will need and then evaluate your options based on that requirement. You don’t want to develop half the course and then realize that the product you selected is not well suited to the level of interactivity you are attempting to implement.

What level of data tracking will you need?

To answer the fourth question, you need to identify the following factors:

- Types of data you want to track (scores, times, question answers, progress, and so on.)
- Which learning management system (LMS), if any, you will use
• Data communication standards compliance (AICC, ADL-SCORM)

How much data tracking do you need? Will you deliver and manage your courseware within a learning management system? If you need to track a lot of data for your e-learning application, you may want to select authoring software that facilitates this task. Macromedia products support a variety of different ways of communicating with tracking systems, including databases and learning management systems. Some Macromedia products have built-in tracking or database connectivity that can greatly decrease the amount of time it takes to capture student and course data.

Macromedia is committed to supporting and implementing learning industry standards and specifications for data tracking, including the AICC (Airline Industry Computer-Based Training Committee) and SCORM Sharable Content Object Reference Model) specifications. These standards define a method of data communication so that your course can track student performance within any learning management system (LMS) that complies with these specifications. For example, there are learning extensions on the Macromedia Exchange for Dreamweaver and UltraDev, such as Manifest Maker, which creates an IMS course packaging manifest that complies with IMS Global Consortium, Microsoft LRN, and ADL-SCORM specifications.

The amount of data tracking you do can range from simple completion status of a course to detailed item analysis covering the number of tries on a question, the answer chosen, and the time spent on the activity. You may want to track data for many reasons, including measuring the return-on-investment, user certification or evaluating the effectiveness of your training. For a more detailed discussion of reasons for tracking data and how it can be accomplished with Macromedia products, please see “Options for Data Tracking” on page 147 in the Macromedia guide, Getting Started with E-learning.

**Data tracking with Macromedia products**

Lessons built with Macromedia authoring software can track data to a database or a learning management system, but they do so in different ways. Authorware provides the most features and simplest approach for accomplishing this task. Authorware has built-in functions and variables designed to work with AICC-compliant learning management systems over a LAN or on the Web. These functions and variables provide an easy and powerful way to track data and communicate with a standards-compliant LMS. Besides featuring built-in tracking capabilities, Authorware supports open database connectivity (ODBC) databases and flat files for tracking applications delivered on CD or corporate networks. Authorware can also call Web scripts to communicate with databases using servers or technologies such as Macromedia ColdFusion, ASP (Application Server Pages), JSP (Java Server pages), PHP (Personal Hypertext Protocol), or CGI (Common Gateway Interface).
Another Macromedia application with strong database connectivity is Dreamweaver UltraDev. This authoring tool provides a powerful development environment for building Web-based applications that communicate with server-side databases using CFML (ColdFusion Markup Language), ASP, or JSP. While Dreamweaver UltraDev does not provide prebuilt functions for communicating with an LMS, developers can create custom behaviors that simplify the task of communicating with a specific back-end system. While setting up data tracking in Dreamweaver UltraDev requires some expertise, it lets you create powerful and highly scalable Web sites.

The remaining Macromedia authoring tools, including Macromedia Director, Dreamweaver, and Flash, can communicate with an LMS or database using custom coding and calls to the same kind of Web scripts supported by Authorware. Director can also use third-party extensions that support database connectivity, and Macromedia Flash supports bidirectional data exchange with another application using XML.

To simplify the task of tracking data to an industry-standard LMS, Macromedia has developed learning extensions and samples for Macromedia Dreamweaver, Dreamweaver UltraDev, Flash, and Director. Links to available learning extensions and samples can be found on the Macromedia Web site in the eLearning Resource Center at www.macromedia.com/learning, and within individual product Exchanges.

Comparing data-tracking capability

The following table rates the capability of Macromedia products to track student and course data. Be aware that this single rating substantially simplifies a complex subject; however, it does provide a relative ranking of each product’s capability to track data for e-learning applications. For a more detailed discussion of how each Macromedia product can communicate with a database or LMS and the pros and cons of each approach, see “Options for Data Tracking” on page 147 in the Macromedia guide, Getting Started with e-Learning.

<table>
<thead>
<tr>
<th>Product</th>
<th>Tracking Capability</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorware</td>
<td>★★★★★</td>
<td>Authorware provides very robust tracking capabilities, ranging from tracking to flat files and ODBC databases to built-in functions for communicating with a learning management system.</td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>★★ ★★</td>
<td>Dreamweaver alone has modest data-tracking capabilities. The CourseBuilder extension for Dreamweaver and UltraDev extension adds basic AICC-compliant data-tracking capabilities.</td>
</tr>
</tbody>
</table>
## Choosing Your Solution

<table>
<thead>
<tr>
<th>Product</th>
<th>Tracking Capability</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dreamweaver UltraDev</td>
<td>★★★★★</td>
<td>Dreamweaver UltraDev has all the capabilities of Dreamweaver plus the ability to connect to server-side databases using CFML, ASP, and JSP. The Learning Site Command is an extension that makes it easy to track to a database or a standards-compliant (AICC) learning management system.</td>
</tr>
<tr>
<td>Director</td>
<td>★★★★</td>
<td>Director has no built-in features for data connectivity or tracking to an LMS. Third-party extensions providing database connectivity are available. All solutions require coding.</td>
</tr>
<tr>
<td>Flash</td>
<td>★★★★</td>
<td>Macromedia Flash has no built-in features for tracking course data. Learning extensions add basic AICC-compliant data-tracking capabilities. Tracking data in a database is best accomplished with middleware applications such as ColdFusion or ASP pages and coding in ActionScript.</td>
</tr>
</tbody>
</table>
How much content will you create?

If you plan to create a large amount of content, you may want to design a data-driven learning system. Data-driven applications rely on templates to pull course content, including media, from a database. To determine whether a data-driven approach to developing learning applications makes sense for you, consider the following:

- Amount and type of content you plan to create
- Importance of reusable content
- Need to enable nontechnical authors
- Availability of technical expertise

Evaluating your development plans

If you plan to create a large amount of content, data-driven solutions can provide a fast and cost-effective way to build your courses. Since data-driven learning is based on templates, courses that are similar in structure and interactivity work best in this model. At first, the task of designing and implementing a data-driven solution is fairly complex and time-consuming. Make sure you have the time and technical expertise to create a data-driven learning system before embarking on its construction. You will need to create the templates for delivering your content as well as the means for populating your database. You may also need to tag and categorize an existing inventory of learning assets.

Advantages of Data-Driven Learning

In the long run, placing content in a database offers many advantages, from ease of application updates and maintenance to significant reduction in the time and cost of creating a course. After the templates and logic for a data-driven learning architecture have been developed, the main tasks required to create a new course are creating and uploading the course content. All of the programming and most of the testing are done. Also, data-driven learning systems can provide a way to involve nontechnical people in the authoring process. Content contribution systems let subject matter experts and production authors add content to an application quickly and easily. They do not need to learn a complex authoring tool and are never in danger of inadvertently harming the code.

Data-driven systems are based on storing and retrieving content from a central repository. When content is tagged with metadata, the repository can provide a searchable source of reusable, sharable content. Another advantage of having content in a database is that you can create dynamic and personalized learning environments. Lesson content can be assembled from the database with different interfaces, different examples, and different levels of difficulty based on learner needs. Dynamic, adaptable learning systems have the potential to meet the needs of learners regardless of age, ability, or learning style.
Macromedia data-driven solutions

Macromedia offers two platforms that excel at enabling data-driven learning: Dreamweaver UltraDev and Macromedia Flash combined with Generator or a server-side database. Dreamweaver UltraDev can create CFML, ASP, or JSP to pull content from a database.

Macromedia Generator is a server solution that composites, produces, and delivers visual content on the fly. Macromedia Flash is the authoring environment for creating the templates Generator uses to produce this content. Generator provides a great deal of flexibility when connecting to data sources, supporting access through ODBC, JDBC, URL calls, Java class files, or text files. Generator produces data-driven Flash applications and automates the workflow. Since Generator uses templates to separate design from content, any changes to the Web content are automatically reflected on the Web site. Generator lets you easily update and modify Flash movies without the intervention of Flash developers.

Some Macromedia customers have designed authoring and delivery solutions using both Dreamweaver UltraDev and Generator together. You can use Dreamweaver UltraDev to create Web forms that instructional designers can use to populate a server-side database with content. For delivery, you use Generator to produce Flash-based learning content that is engaging and scalable, in addition to performing well over low bandwidth.

Authorware and Director can be used to create data-driven learning applications as well, though neither product is optimized for this approach. Creating data-driven learning with these products involves getting them to connect to a database and then coding custom routines to populate a template with content.

Comparing data-driven capability

The following table rates the ability of Macromedia authoring products to produce data-driven learning applications.

<table>
<thead>
<tr>
<th>Product</th>
<th>Data-driven Capability</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorware</td>
<td>★★★★★</td>
<td>Authorware is not designed to pull course content from a database. Developers can create data-driven learning using Authorware’s support for ODBC, third-party database extensions, or JavaScript URLs to communicate with application servers.</td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>★★★★★</td>
<td>Dreamweaver is not designed to pull course content from a database. Data connectivity is available with Dreamweaver UltraDev.</td>
</tr>
</tbody>
</table>
To answer the sixth question, you need to identify the following information about the staff who will build your learning application:

- Current skills with authoring tools
- Current skills with content-creation and editing applications (such as graphics, illustration, and video-editing programs)
- Technical aptitude, or proficiency at learning new software
- Propensity toward design, instruction, or programming

Each Macromedia product has been designed with specific users in mind. Some products are targeted to designers, while others are designed for developers. Each product involves a slightly different set of technologies, and each has a unique lineage. These differences affect product design and determine the skill sets required to effectively use each one. Understanding the design center of each product and objectively evaluating your own technical skills will help you make a wise selection of authoring products.

### What is your technical skill level?

<table>
<thead>
<tr>
<th>Product</th>
<th>Data-driven Capability</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dreamweaver</td>
<td>Low</td>
<td>Dreamweaver UltraDev is designed expressly for creating Web-based applications. The ability to create ASP, JSP, and ColdFusion applications makes Dreamweaver UltraDev a powerful platform for creating data-driven learning applications.</td>
</tr>
<tr>
<td>UltraDev</td>
<td>High</td>
<td>Director is not designed to pull course content from a database. Developers can create data-driven applications using XML parsing, third-party database extensions, or JavaScript URLs to communicate with application servers.</td>
</tr>
<tr>
<td>Director</td>
<td>High</td>
<td>Director is not designed to pull course content from a database. Developers can create data-driven applications using XML parsing, third-party database extensions, or JavaScript URLs to communicate with application servers.</td>
</tr>
<tr>
<td>Flash and Generator</td>
<td>Low</td>
<td>Flash supports the creation of data-driven applications in several ways. Developers can use Flash together with Generator to produce dynamic, data-driven Flash applications. With Generator, data can be directly accessed through ODBC, JDBC, URL calls, Java class files, or text files. Other approaches for creating data-driven content with Flash include using XML or JavaScript URLs to communicate with application servers.</td>
</tr>
</tbody>
</table>
Determining your skill level

If you plan to learn a new product from scratch, determining your current skills and technical proficiency will help you decide which software is most appropriate. Two important factors that affect your skill level are prior experience with authoring software, multimedia development, and Web technologies, and your proficiency with scripting and programming languages.

If you have experience with authoring software, multimedia, and Web technologies, your skills apply to the technical challenges of developing e-learning. While technical expertise is not a replacement for knowledge of instructional design, it does provide a foundation upon which you can build. You or others in your organization may already have skills using Macromedia Web authoring products such as Flash or Dreamweaver.

A second valuable skill set is proficiency with scripting and programming. Knowledge of almost any scripting or programming language can help you learn the scripting language associated with your tool of choice. The type and amount of scripting required to develop e-learning applications varies across the Macromedia authoring products.

Macromedia products and ease of use

Of all the Macromedia products, Authorware requires the least amount of scripting to develop interactivity for learning. Authorware is designed primarily for learning developers and instructional designers. The metaphor used in the product’s user interface is an icon-based flowchart. You can drag icons onto a flowchart, set menu-based options, group related icons together, and create scripts in the Authorware scripting language, Calculation language. This ability to drag icons onto a flowchart and encapsulate functionality makes it very easy to create learning applications that are large and highly branched.

Macromedia Director and Flash accomplish interactivity and branching primarily through scripting in Lingo or ActionScript, respectively. Both applications provide ways to simplify scripting by providing user-defined functions and prepackaged scripts. Both products use a timeline based metaphor, which is particularly useful for animation, synchronizing media elements over time, and for creating simulations. The Flash scripting language, ActionScript, closely matches the structure and syntax of JavaScript and is based on the same ECMAScript standard. This makes it easy for Web developers to transfer their scripting skills to authoring with this product.
Macromedia Dreamweaver lets you easily define and lay out Web sites and create basic content pages. Most authors find the basic page-based metaphor of the product easy to understand and use. Features like Layout view for designing pages, Dream Templates for maintaining consistency and the Dreamweaver Object panel make authoring basic content pages easy. If you want to add more than interactivity to your site, you will need to use JavaScript. Fortunately, Macromedia provides learning extensions that let you add interactivity without having to learn JavaScript. As noted in the preceding section on interactivity, there are some limitations to the kinds of logic and interactions that are possible with HTML alone.

Dreamweaver UltraDev provides all the strengths of Dreamweaver plus the ability to create data-driven applications and connect to databases over the Web. While Dreamweaver UltraDev dramatically simplifies the development of this type of application, working with application servers, databases, and server-side technologies demands more complex technical skills than does working with Dreamweaver alone. These technical skills might include an understanding of ASP, JSP, ColdFusion, Oracle, SQL, or MS Access.

**Macromedia learning extensions**

For all Macromedia general-purpose authoring software, Macromedia has developed learning extensions and samples to help new users and developers create e-learning applications. Authorware is the exception, since it already has many learning-specific features. Macromedia learning extensions and samples provide pre-scripted code or examples of how to create common learning elements including:

- Course navigation
- Learning interactions
- Quizzes
- Tracking

Macromedia Dreamweaver and UltraDev have an extensive set of learning extensions, including the Course Builder extension, the Learning Site Command, and several extensions that support the development of standards-compliant content. All of these extensions can be downloaded for free from the Macromedia Exchange for Dreamweaver, www.macromedia.com/exchange/dreamweaver, and the Macromedia Exchange for Dreamweaver UltraDev, www.macromedia.com/exchange/ultradev.

For Macromedia Flash, a set of learning interaction Smart Clips is already part of the product. This set can be found under the Help > Common Libraries > Learning Interactions submenu. Additional learning extensions, including documentation, are available for download for free from the Macromedia Exchange, at www.macromedia.com/exchange/flash.
For Macromedia Director, a learning sample has been developed that demonstrates how to create instructional content. The sample course lets you develop prototypes and simple instructional modules. It also provides a well-structured example that includes sample Lingo and behaviors used to create common learning elements. The Director learning sample is available for download from the Macromedia Web site in the eLearning Resource Center, www.macromedia.com/learning.

Comparing ease of authoring

The following table rates the ease of use of each Macromedia tool for basic to advanced e-learning projects. This rating system oversimplifies a complex subject; however, it provides a relative ranking of the skills required to develop e-learning applications with each product.

<table>
<thead>
<tr>
<th>Product</th>
<th>Project Level</th>
<th>Ease of Use Low → High</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorware</td>
<td>Basic</td>
<td>★★★ ★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>★★★★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★ ★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>★★★★ ★</td>
<td></td>
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<td></td>
<td></td>
<td>★★★ ★★</td>
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<td></td>
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<td>★★★ ★★</td>
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<td>★★★ ★★</td>
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<td>★★★ ★★</td>
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<tr>
<td></td>
<td></td>
<td>★★★ ★★</td>
<td></td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>Basic</td>
<td>★★★★★ ★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>★★★ ★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★ ★★</td>
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<td></td>
<td></td>
<td>★★★ ★★</td>
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<td></td>
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<td>★★★ ★★</td>
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<td>★★★ ★★</td>
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<td>★★★ ★★</td>
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<tr>
<td></td>
<td></td>
<td>★★★ ★★</td>
<td></td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>Basic</td>
<td>★★★★★ ★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>★★★ ★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★ ★★</td>
<td></td>
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<td></td>
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<td>★★★ ★★</td>
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<td>★★★ ★★</td>
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<tr>
<td></td>
<td></td>
<td>★★★ ★★</td>
<td></td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>Basic</td>
<td>★★★★★ ★</td>
<td></td>
</tr>
<tr>
<td>UltraDev</td>
<td>Intermediate</td>
<td>★★★ ★★</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>★★★ ★★</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>★★★ ★★</td>
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<td>★★★ ★★</td>
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<td>★★★ ★★</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>★★★ ★★</td>
<td></td>
</tr>
</tbody>
</table>

Authorware is accessible to new users with nontechnical backgrounds. The product also has the capability to produce advanced projects. Authorware’s extensive learning features make it the most productive authoring software for developing e-learning applications. It is exceptionally strong for rapid prototyping. Lack of a fully featured scripting language may limit some developers on the high end.

With Dreamweaver you can easily create basic content and applications. Macromedia learning extensions simplify the tasks involved in creating common learning elements. Dreamweaver does not address advanced applications well because of the limitations of the browser and JavaScript, the difficulty of tracking user interactivity, and the need for scripting.

Dreamweaver UltraDev has the same strengths and limitations as Dreamweaver, plus additional capabilities for advanced developers who want to develop data-driven applications or track information to a database.
Additional considerations

After you’ve answered the six key questions, you may have already decided which products will work best for your needs. However, you may have requirements that compel you to consider some additional questions. For example, do you plan to localize your application (translate it into other languages)? Do you have skilled staff members who can create reusable elements for a less experienced staff? Do you need to integrate your learning application with other applications? Do you want to create custom extensions?

The following additional considerations can affect your choice of authoring software:

- Ease of updating
- Templates and reusable code
- Programmatic extensions
- Collaboration features
- Accessibility

**Product** | **Project Level** | **Ease of Use** | **Comments**
--- | --- | --- | ---
Director | Basic | ★★★ | Director is moderately accessible to the new user who wants to create basic learning applications. The richness of the product, combined with Lingo scripting, make the learning curve for Director somewhat steeper than other Macromedia products. These same qualities, combined with reusable scripts and strong programmability, offer tremendous power and flexibility for the intermediate and advanced developer.

Director | Intermediate | ★★★★ |  |
Director | Advanced | ★★★★★ |  |

Flash | Basic | ★★★★ | Macromedia Flash is moderately accessible to the new user who wants to create basic learning applications. Macromedia learning extensions simplify the tasks involved in creating common learning elements. Additional interactivity requires a familiarity with ActionScript, which is similar to JavaScript. Reusable components such as Smart Clips can help developers encapsulate and reuse code.

Flash | Intermediate | ★★★★ |  |
Flash | Advanced | ★★★★ |  |
Choosing Your Solution

Updating your application

How often will you need to update your application? If the answer is frequently, then you may want to consider an application that makes it easy for you to separate your content and media assets from the logic of the application. One solution is to create data-driven learning applications. This approach has already been discussed at some length above, in the section, “How much content will you create?” on page 54. A second approach is to leverage support for external media within Macromedia authoring products. Using external media (linking to media rather than importing it) lets you edit course content easily without having to re-author or repackage your course. External media also allows for easy translation of courses into other languages. Once again, all the products support this approach, but some make it easier to accomplish than others.

Both Authorware and Director provide the option to create links for media assets at the time that an asset is incorporated into the course. Flash lets authors update any imported media and republish the project. When combined with Generator, Flash movies can be dynamically created containing different graphics or sounds based on data in a database or text file. Courses developed in Dreamweaver are easy to update, thanks to the open nature of HTML files. You can use templates or external content to quickly swap out or modify any element in a course. The ability to quickly and easily update your application will reduce the cost and time spent in application development and maintenance.

Templates and reusable code

All of the Macromedia products let you create templates and reusable code, speeding up the development of learning applications. Each product does so in a different way.

In Authorware, you can create templates, also known as models, or Knowledge Objects. The difference between models and Knowledge Objects is that Knowledge Objects have an associated wizard, which makes it easy to fill in content and set parameters. The strength of Authorware models is that they can encapsulate functionality in a single drag-and-drop icon. To create a model, you simply save a group of icons as a model; others can then use that same code in their application. A model can provide a login routine, a complete quiz, or even an entire application structure. Authorware comes with a gallery of Knowledge Objects; you can also create your own. While Authorware has its Calculation scripting language, it does not offer a script library for storing and changing reusable code in a central location.

Dreamweaver and UltraDev provide extensive capabilities for creating templates and reusable code. Authors can create Dream Templates, which define the layout of a page and also define which regions of the page are editable. These templates can then be made available to production authors or less-sophisticated users. Dreamweaver and UltraDev also let users create custom behaviors and extensions. Behaviors include custom JavaScript that can be saved to the Dreamweaver Behaviors panel for later reuse. Behaviors can also include sophisticated server-side scripting,
Dreamweaver extensions are developed in JavaScript as well but are more robust than behaviors. Extensions have the ability to modify the Dreamweaver and UltraDev interface and menu system, and can have a user interface of their own. For example, the CourseBuilder extension for Dreamweaver and UltraDev adds a new Learning category to the Object panel and adds an icon to the panel. The Learning Site Command adds a new item to the Site menu and provides an easy-to-use interface for building a learning site.

Finally, you can create a customized version of Dreamweaver and UltraDev for your team that contains only the commands that you want for course development.

Director does not have simple ways to create templates, but it does offer powerful ways to create reusable code. Director lets you save Lingo code in behaviors that you can save to a library for later reuse. Behaviors are added to media through a simple drag-and-drop procedure from the library. Director behaviors are more granular than Authorware templates. For example, a behavior might be used to define feedback on a button. To create a complete multiple-choice question, you would need to combine several behaviors addressing feedback on each choice, scoring, tracking and so on. Behaviors are very flexible and can be maintained in a central library. If a behavior is modified in the library, that change will be reflected throughout the application.

Flash also provides ways to encapsulate and reuse code. You can create Smart Clips, which are Flash movie clips with associated parameters. The parameters can be set in a list or through a custom user interface designed in Macromedia Flash. Macromedia Flash Smart Clips typically encapsulate less functionality than Authorware templates, but more functionality than Director behaviors. Macromedia Flash 5 includes a set of Learning Interaction Smart Clips that provide different question interactions (see the submenu Window > Common Libraries > Learning Interactions in Macromedia Flash 5). You can also create user-defined functions in Flash by using ActionScript. While this feature provides a way to write a reusable function, it does not offer a central place to edit it. Another way you can leverage reusable code in Macromedia Flash is by creating and calling external scripts.

A final way you can write reusable code in Flash is to combine Flash with Macromedia Generator. Flash is the authoring environment for creating Generator templates. These templates are reusable components that separate design from content. Generator pulls content including data and media from a database or a file system and then populates the template and generates dynamic Flash-based content.

All Macromedia products support templates and reusable code, in different ways and at different levels. Depending on your requirements and team skills, one approach may meet your needs better than others.
**Programmatic extensions**

You might have very specialized requirements that are not addressed directly by the authoring software. For example, perhaps you want to integrate an unsupported media type such as Adobe Acrobat documents, use a specialized Windows control such as a calculator, or add encryption to your data files. In these cases, authoring software that can be enhanced with custom extensions is very valuable.

Authorware and Director provide the most flexibility for extending the run-time capabilities of the product. Both products let you develop and use custom extensions such as ActiveX controls, DLLs, XCMDs, and Xtras. The Macromedia Xtras API provides a way to extend capabilities during authoring as well as at run time. Many third-party developers have used this architecture to create extensions that cover everything from database access to specialized printing capabilities.

A list of third-party Xtras is available on Macromedia’s Web site, www.macromedia.com/software/xtras/. When it comes to ActiveX controls, there are hundreds, if not thousands, of commercially available controls, as well as many Web-based resource sites. The ability to use extensions like Xtras, DLLs, and ActiveX controls provides a way to add functionality to Authorware and Director.

Dreamweaver and Dreamweaver UltraDev are built on an open and extensible API that has allowed Dreamweaver developers to create extended functionality for these products. The Macromedia Exchange for Dreamweaver and UltraDev provide hundreds of free extensions that add authoring functionality supporting rich media, navigation, accessibility, security, design, and more. Macromedia Flash does not have an API for extending the product, but Flash developers can create reusable code and share it on the Macromedia Exchange for Flash.

**Collaboration**

Collaboration is an important component of e-learning applications. Users interact with one another or with instructors to help answer questions, share knowledge, and create community. The Director Shockwave Studio comes with the Shockwave Multiuser Server that lets you create online chat, whiteboards, and multiuser applications. A 2000-user server license comes with the Director Shockwave Studio.
Accessibility

There are 750 million people worldwide with disabilities, representing about 5% to 10% of the Web user community—including people with limited visual, auditory, physical, and cognitive abilities. As use of the Web has grown, people with disabilities have increasingly turned to the Internet as an invaluable resource for information, education, and training. People with disabilities who author Web sites and content largely rely on the accessibility features of their operating system to support their work within development applications, which may include magnification, change of display colors to high contrast, text-to-speech conversions, and shortcut keys. People with disabilities who access the Web use a range of techniques to find information, such as enlarging the font size on their browser, using a magnifier provided in their operating system, or using a text-to-speech browser or a reader that adapts the screen text to Braille.

The United States has passed several laws asserting the rights of the disabled, most notably the Americans with Disabilities Act (ADA). Some people use the term “ADA-compliant” to refer to accessibility, but there are other notable regulations that govern accessible technology, such as Section 508 and Section 255.

By June 21, 2001, all federal Web sites will be required to be accessible. Federal agencies will also require that software they purchase meet accessibility standards. Further, several large, consumer-focused Web sites have been successfully sued to require accessibility, so it is likely Web accessibility will become a broader concern. While legislation does not specifically address training and educational content, Macromedia recommends that all Web content be developed with accessibility features to address all types of users.

There are three ways to address accessibility: during development, checking compliance, and updating content. Macromedia offers tools that let you address all three of these tasks. Documentation of the accessibility features of Macromedia’s Web authoring tools can be found on the Macromedia Web site, at www.macromedia.com/accessibility. Feature and extension development to support accessibility includes the following:

- Free extensions for Macromedia Dreamweaver and Dreamweaver UltraDev that enable developers to evaluate their Web pages for accessibility based on the guidelines of the World Wide Web Consortium (W3C). The extension performs a test similar to that of Bobby, a standard online benchmark for accessibility.

- Free extensions for Macromedia Fireworks that provide developers with multiple ways to ensure that alternate text is provided for images.

- Free Macromedia Flash accessibility kit for developers, including techniques, guidelines, and example code.
Matching a Macromedia product to your needs

You have now examined the important considerations that can affect your choice of products. You may have already come to a decision based upon a single overriding requirement. If not, now is the time to evaluate all of the options together and select which product or combination of products best fits your needs. We are providing a worksheet to help you with this task. It helps you to compare all of the products based on the six questions we have presented. It also has an “Other” category, which lets you add and give weight to any additional considerations that are important to you. Keep in mind that most learning projects are delivered using a combination of products.

Use the worksheet to score how well each product meets your authoring and delivery requirements. We suggest you assign points to a product according to how well it meets your needs in each category as follows:

15 points = Excellent
10 point = Reasonable
5 points = Poor

In the worksheet, each criterion has equal weight. If some criteria are more important to you than others, you can modify the weightings according to your needs. Just make sure that the total of all the weights is 1.0.

After you have rated each product, multiply the product score for each question by the question's weight. Place this number in the product Score column. The Considerations column is where you can jot down any special comments you have. Once you have rated products for all questions, add up the scores by product, and enter that number in the Total score row at the bottom. The product with the highest score is the best overall fit for a given set of requirements.
### Product comparison worksheet

<table>
<thead>
<tr>
<th>Question</th>
<th>Weight (optional)</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author-ware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dream-weaver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where are you delivering your e-learning?</td>
<td>.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What kinds of media will you use?</td>
<td>.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the level of interactivity?</td>
<td>.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What level of data tracking will you need?</td>
<td>.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much content are you planning to create?</td>
<td>.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is your technical skill level?</td>
<td>.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other considerations (Add your own)</td>
<td>.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After you complete this worksheet, you’re done, right? Well, almost! This worksheet is a rough tool intended to get you to ask the right questions about the authoring software you are considering. It will give you guidance about the relative strengths of each tool for your needs or for a specific project. Once you have some answers, we still advise you to try your selections. Macromedia provides 30-day trials for all our authoring software. The trial software can be downloaded for free from the Macromedia Web site, at [www.macromedia.com/downloads/](http://www.macromedia.com/downloads/).
Resources

The following sections list online resources to help you find information about Macromedia products, learning development, and related topics.

Development resources
Macromedia eLearning Resource Center
www.macromedia.com/learning
Authorware
www.macromedia.com/authorware/
Dreamweaver
www.macromedia.com/dreamweaver/
Dreamweaver UltraDev
www.macromedia.com/ultradev/
Director Shockwave Studio
www.macromedia.com/director/
Flash
www.macromedia.com/flash/
Generator
www.macromedia.com/generator/
Shockwave and Flash Player FAQ
www.shockwave.com/help/faq_swplayer.html
Authorware Web Player AutoInstall
www.macromedia.com/support/authorware/web/a5autoin/a5autoin.html

Training resources
Macromedia University
E-learning classes on Macromedia products
www.macromedia.com/university/
Macromedia authorized training centers
www.macromedia.com/support/training/atlocator.html
Authorware publications
Dreamweaver publications
Director publications
www.macromedia.com/support/director/ts/documents/tn3102-dirpubs.html
Other Macromedia resources
Macromedia Exchange has free, easy-to-install extensions for Macromedia products
www.macromedia.com/exchange/
Macromedia Showcase gallery of examples
www.macromedia.com/showcase/

Accessibility resources
Macromedia accessibility site
www.macromedia.com/accessibility
U.S. government requirements for accessibility
www.section508.gov
W3C recommendations for accessibility
www.w3.org/WAI
CHAPTER 3  
Instructional Design for E-learning

by William Horton, president, William Horton Consulting, Inc.

Instructional design is the architecture of learning. This chapter provides a “survival kit” that introduces the basic principles and process of instructional design. It provides guidelines for matching training methodologies to training tasks, as well as principles that govern effective information design for online display.

Instructional design is critically important for e-learning. In the classroom, much of the instructional design of a course is implicit in the experience and wisdom of the instructor. In OL, the instructional design must be explicit in the selection, sequencing, and creation of experiences that cause learning to occur.

This chapter is no substitute for a complete understanding of the science and art of instructional design or for the services of a skilled instructional designer. If you are an instructional designer or your project team includes a designer, you can probably skim this chapter; if not, read this chapter carefully.

What is instructional design?

Instructional design systematically applies scientific principles to the task of designing effective instruction. It guides designers toward successful designs and collects the results of research and experience into a growing body of knowledge available to designers.

Instructional design is both a systematic process for preparing a program of instruction and an organized collection of scientific principles about how people learn. Both process and principles are important; neither alone is sufficient to guarantee success.
The instructional development process

The process of instructional design is essentially an engineering development process, not unlike that for constructing a highway overpass or creating a video game. The process consists of a cycle of four main activities:

Let’s consider each phase and the tasks it involves.

**Analyze - Determining the learning need**

The first step in any complex project is to set realistic goals. To set goals for an instructional design project, start with the business goals that indicate a need for training. Analyze the potential learners to identify their capabilities and need for learning. Then compare the target levels of knowledge or performance to each learner’s current levels to determine what the course or program must teach.
Starting with business goals

To set the learning goals for your project, start with the business or organizational goals that led to the need for training in the first place. By showing how learning goals can accomplish business goals, you ensure management support and simplify obtaining funding for your project.

The table below shows a business goal translated into a learning goal as part of a larger business solution.

<table>
<thead>
<tr>
<th>Business goal</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase sales of optional features for the ZipOTronique 3000 (ZoT 3K) by 30%</td>
<td>Learning goal: Train sales representatives to identify optional features that meet customer needs Other solutions Increase the sales commission on optional features Publish online and paper data sheets touting the benefits of optional features</td>
</tr>
</tbody>
</table>

It is important to understand the difference between business goals and learning goals. Business goals specify objectives within a business organization; learning goals specify one way to accomplish them. While learning goals should support business goals, they are seldom the only way to accomplish a business goal and often work best in tandem with other measures.

Learning about learners

The more you know about learners, the better you can design instruction for them. You must know their goals, capabilities, and motivations. Because you have less control about when, where, and how learners take online training, you must know considerably more about them than their classroom counterparts.

What do learners want to learn?

For a captive classroom audience, instructors often focus on what they want to teach. But online learners are never more than a mouse click away from dropping out; you must focus on exactly what they want to learn. Ask the following questions to determine your learners’ goals:

**Why are they learning?** What motivates your learners? Are they learning to satisfy curiosity, to prepare for a new career, or to meet a certification requirement?

**How much do they want to learn?** Do they want to learn about a subject in depth or only how to perform one isolated task?

**What kind of knowledge do they seek?** Do learners want general, abstract principles that apply broadly or concrete procedures to solve a specific problem?
Where are they when they learn?
Will people take your training course in a private office, in a cramped cubicle, on a noisy factory floor, from a home office, in a lonely hotel room, on a beach, or aboard the Concorde? Over how many time zones and nations are your learners scattered?

When will they take the course?
Will learners take your course during office hours, in the evening, or on weekends and business holidays? Will they prefer to take your course in regular sessions or in learning binges?

How can they learn best?
How will your learners prefer to learn? What modes of presentation will be most effective? To answer these questions, you must know about the basic learning skills and abilities of your learners.

Language skills. How well can learners read, write, and speak the language of your course? A course for native-speakers of a language can use more complex language than one for those who speak the language as a second language.

Typing skills. Are learners rapid and capable typists? Poor typing skills can limit a learner’s participation in chat sessions, for example.

Physical abilities. Not everyone has the reflexes and eye-hand coordination of a fighter pilot. Designs that require quick and precise pointing on the screen, speed-reading of text, instant understanding of voice narration, and touch-typing may not work for everyone. Some learners may suffer from hearing loss, dyslexia, or visual impairments.

Motivation. Are learners self-motivated enough to learn on their own? Or do they require the authority of an instructor, the social pressure of peers, and the drumbeat of a definite schedule in order to learn?

What technology can learners use?
To determine the technologies to use in your course, first determine what technologies learners can obtain and master. If your potential learners have never used a Web browser and your course requires them to add memory to their computer, upgrade their operating system, and install and operate sophisticated videoconferencing hardware, your potential learners may not become actual learners.
Measuring learners’ current knowledge

Knowing the learners’ current level of knowledge and expertise is critical to a successful design. If your course begins below the current knowledge-level of learners, they may feel that it is boring, a waste of time, or patronizing—and they may stop learning. If your course begins above their level, they may become frustrated and discouraged. If learners have various levels of expertise, you must design your course so that learners at each level can start at a different point or skip over unnecessary material.

To determine what learners already know, you can choose from an array of mechanisms such as questionnaires, surveys, tests, interviews, and focus groups. Obviously you need to test potential learners, but do not forget to include their supervisors, especially if you are developing job-related training. Often supervisors can gauge the skills and knowledge of workers better than the workers themselves.

Specifying the results you want to achieve

The final step of the analysis phase is to use your research results to convert your general goal into a performance objective stating precisely the results that your course will achieve. Here is a simple formula for crafting such an objective:

<table>
<thead>
<tr>
<th>People</th>
<th>Goals</th>
<th>Conditions</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who are the learners?</td>
<td>What is their goal?</td>
<td>What are the circumstances?</td>
<td>Time required to successfully achieve the goal?</td>
</tr>
<tr>
<td>Sales representatives for the ZipOTronique 3000 (ZoT 3K)</td>
<td>How to match customer needs to optional features that meet those needs.</td>
<td>In face-to-face meetings and telephone conversations with customers, without access to written or online materials.</td>
<td>90% of sales reps will recommend the optional features that best match customer needs.</td>
</tr>
</tbody>
</table>

This objective becomes your contract with learners and those paying for development of the course. Keep this objective in mind as you develop all phases of the course.

Design - Deciding how to meet your goals

In the design phase of instructional design, you translate your objective into a specific plan. To do this, you must divide a high-level goal into lower-level subgoals until each goal is specific enough to be taught with a single, perhaps complex, learning experience.
Setting specific learning goals

As you begin to deconstruct the objective for your course and to specify subgoals, ask yourself and your team members this question:

In order to meet this goal, what else must the learner learn?

Each answer provides another subgoal, which you need to either subdivide or specify a learning experience for.

In determining subgoals, consider all the different kinds of topics you can teach:

- **Skills**
  
  What skills will learners have? What new procedures can they perform if required to?

- **Knowledge**
  
  What understanding will they possess? What decisions can they make based on their current knowledge?

- **Beliefs**
  
  What beliefs do they hold to be true? Do you need to convince learners of some principle or fact?

- **Attitudes**
  
  How will they feel about a subject? Are there biases you need to erase or instill?

It is important to be clear about exactly how a learning goal will benefit learners. Teaching someone how to perform a quality-control procedure (a skill) may be of no use if they feel that only speed of production is important (an attitude).
Identifying learning experiences

For each lowest-level goal, identify a single learning experience that will accomplish the goal. First decide what you want the learner to experience, then determine what technology best delivers that experience.

Learning experiences are limited only by the imagination of the designer—and perhaps a bit by the technology available. Web technologies can deliver a wide range of learning experiences. The following examples are only a fraction of possible experiences:

- Examining good and bad examples
- Performing a procedure or playing a role
- Planning and conducting experiments
- Listening to someone tell a story
- Answering questions on a subject
- Searching for relevant resources
- Participating in a discussion
- Gathering and analyzing data
- Repeatedly recalling and applying knowledge
- Creating work and having it critiqued by others
- Critiquing the work of others
- Watching a video or animation sequence
- Comparing, contrasting, and summarizing information

For example, to teach sales representatives about concerns to listen for when trying to identify the needs of customers, you might present a series of sample customer statements (in text, audio, or video), each followed by a statement of the concern the example illustrates.
Deciding how to implement each experience

Once you have decided what experience will accomplish each objective, you need only decide how to implement each online experience. There is no magic recipe for mapping experiences to Web technologies, but you may find this two-step procedure helpful.

1 Decide the best possible way to trigger the desired experience. Ask yourself what method would produce the purest and most effective learning experience?

2 Decide the best way to implement the experience using Web technologies available to your learners. Ask yourself how you can most closely approximate the ideal learning experience? What are the technical limitations? Are there alternative technologies or work-arounds for these limitations?

Packaging each experience as a module

To create the learning experience, you combine the goal and learning experience into a self-contained module (often called a learning object). Make sure each module contains components that accomplish the following tasks:

- Introduce the subject by including a title and short paragraph to put the subject in context.
  For example: “Listening for customers’ concerns.”

- Motivate the learner by clearly explaining the value of learning this subject.
  State the objectives that the learner wants to accomplish. Let the learner take a test or play a game that demonstrates their need for the knowledge. For example, you might begin with a statement such as: “The more customer concerns you can identify, the better you can select optional features to meet these concerns. The result will be more and easier sales.” This motivational introduction might be displayed on the screen or spoken by an online sales coach in an audio voice-over or video.

- Present the subject by clearly stating the main idea or goal.
  For example, you could develop a checklist of customer concerns by presenting a customer statement on the left side of the screen, with the concern the statement illustrates added to a list on the right edge of the screen.

- Let learners practice the skills and knowledge they learn by including a test question, simulation, or some other activity.
  To test the ability to identify customer concerns, for example, you could present more examples of customer statements, but this time you might require learners to identify which concern the statement illustrates.
• Summarize the subject by including a concise and absolutely clear statement of the main point of the module.

For example, you could display a checklist of the customer concerns that sales representatives should listen for and encourage learners to print the list and keep it handy.

• You know your learners and you know your subject.

If a component is unnecessary, leave it out. Combine and rearrange components to best meet your goals. For example, to implement discovery learning, place the practice component before the presentation component and merge the practice component with the summary.

Defining standards

Standards specify aspects of design that apply throughout the project. For example, using font and color standards ensure that the fonts and colors used in HTML pages created by one designer in Dreamweaver match those in a graphic created by another designer in Freehand. Designers typically set standards for colors, fonts, layouts, button behaviors, and other aspects of the user interface.

Build – Creating learning experiences

Once you have articulated your design, you are ready to begin building your course. The instructional design process doesn’t specify the tools and methods you use to build a learning experience. However, it’s important to keep instructional design principles in mind as you make decisions about creating the individual multimedia content modules, presentation topics, and other components of the course.

To reduce development effort and ensure consistently high quality, you may want to begin the construction phase by creating page templates and other reusable elements for common pages and interaction types.

Such page templates are partially completed components with editable areas where courseware developers can pour their content. A page template might include a course emblem and navigation buttons already in place while leaving placeholders for the page title and other text, graphics, or video content.

An interaction template might include editable areas for text and graphics to display as well as all the scripting necessary to provide feedback to the learner.

Note: Do not delay the building phase until you have perfected your design. Instead use early prototypes to test and refine your designs. Build early and often.
Evaluate – Measuring effectiveness

No course is perfect and every course can be improved. As soon as you build your course, you should evaluate its effectiveness. Such an evaluation will guide you in efforts to continually improve the course.

Offering a pilot course

The first step in evaluating a course is to conduct a pilot offering of the course. Plan a pilot offering early enough so that you have time to correct any mistakes you discover and any misunderstandings brought to light in the initial learners.

To conduct a pilot offering:

1 Recruit learners.
   Select people with the same needs, motivations, and background as those who will eventually take your course. Make the group large enough that results will be meaningful but small enough for the group to be manageable.

2 Prepare the learners.
   Explain the purpose of the pilot course and provide any background information.

3 Monitor current performance.
   Measure the work performance, knowledge, and attitudes of the test group. Establish a baseline against which you can measure improvement.

4 Conduct the training.
   Make the pilot offering as realistic as possible.

5 Measure results.
   Compare the performance, attitudes, and knowledge of the group to that measured before the training.

Analyzing results

Compare the results of the pilot offering to the goals for your course. Did learners learn what they were intended to learn? Which objectives were fully met and which only partially?

For objectives that were not fully met, try to identify what went wrong. Were presentations confusing? Did learners lose motivation? Did technical glitches interfere with learning?

Also, examine the cost-effectiveness of the pilot. Were there unexpected costs? Did learners require more time than anticipated to complete the course?
You may find it helpful to summarize your evaluation in a concise report. To make your report effective, stress successes and recommendations for improvement rather than dwell on failures or apportion blame. In short, just focus on how to improve the course.

Revising the course

Good instructional design is never a linear, one-time process but an ongoing cycle of development. By continually analyzing, designing, building, evaluating, and redesigning, we sneak up on perfection—or at least effectiveness. In general, the more design cycles you can employ, the better your final design will be.

You may want to adopt a “rapid-prototyping” approach. Build a single lesson or smaller module and test it immediately. Then apply what you learn from testing this small component to the design of other components and the course as a whole. The sooner you test your design, the more chances you have to apply what you learn.

Effective training principles

Over centuries, psychologists in laboratories and teachers in classrooms have observed that certain training techniques are more effective than others. This section discusses some of the principles of effective learning and their implications for the design of your training. Each principle has several related concepts and guidelines, indicated by these symbols:

- **Concepts** present general or abstract principles.
- **Guidelines** provide specific guidance on how to apply a principle.

Motivation fuels learning

Probably the most critical factor in learning is the motivation of the learner. As a designer, you must ensure that online learners are properly motivated.
Motivation is the most important factor

History offers inspiring examples of how motivated individuals have overcome great obstacles to educate themselves. Helen Keller and Booker T. Washington are two prime examples.

With proper motivation, learners surmount difficulties and overcome problems that would stymie their less-motivated counterparts. The field of e-learning is new and poses many unexpected obstacles to learners. It may require a higher level of motivation from learners than do more established forms of learning.

Motivations are internal and external

Motivation can be either internal or external. Internal motivation works from within the individual. The internally motivated learner learns in order to satisfy curiosity or purely for self-fulfillment. Externally motivated learners act to satisfy outside needs, such as to achieve a required certification, to please the boss, or to avoid embarrassing mistakes.

Classroom training provides ample doses of external motivation such as the encouragement of the instructor and fear of embarrassment in front of fellow learners. Learners who use e-learning, however, must rely more on internal motivation and, in fact, e-learning may be better suited for learners with already high levels of internal motivation or with a direct external motivation, such as meeting a certification or licensing requirement.

Clearly state the benefits of learning

Learners, especially adult learners, demand to know what they will accomplish through learning. They need to know “What’s in it for me?” How will learning make them healthier, wealthier, or happier?

A statement listing the educational objectives of the course is seldom sufficient to motivate learners today. Compare these two course objectives:

<table>
<thead>
<tr>
<th>After completing this course, sales representatives handling the ZipOTronic 300 will be able to:</th>
<th>This course will teach you to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>List the optional features for the ZoT 3K</td>
<td>Sell 30% more optional features for the ZoT 3K</td>
</tr>
<tr>
<td>Recall a significant customer benefit for each optional feature</td>
<td>Feel more confident and in control when confronting customers</td>
</tr>
<tr>
<td>List the customer concerns that lead to the purchase of each optional feature</td>
<td>Overcome sales resistance before it even arises</td>
</tr>
</tbody>
</table>

Which objective would appeal to most people? The first objective explains what the course teaches but the second describes what the learner will gain by taking it.
Invoke curiosity

Curiosity is one of the most powerful motivators. You can use it in e-learning to plant questions in the minds of learners that they can best answer by taking the course. Here are some ways to use curiosity to motivate online learners:

- Start with a pretest that leaves learners wanting to learn why their answers were right or wrong.
- State a problem that the course will teach how to solve and make it a problem experienced by most learners.
- Show desirable results that learners can accomplish by completing the course.
- Include evolving content, such as new material, news events, links to ongoing discussions, or live feeds from a video camera or stock market ticker.

Challenge learners

Overcoming challenges is inherently motivating. This is why people spend time solving puzzles, playing games, and exploring interesting places? Use the following techniques to make your course effectively challenging:

- Increase the difficulty gradually.
  Make sure that all learners can get started but none run out of challenges.
  Include a few easy questions on tests and a few very difficult questions.
- Acknowledge progress by providing encouraging feedback to learners as they move through the course.
  Promote them through a series of levels, as in video games.
- Layer materials by providing deep reserves of optional material so that learners who are interested in a particular part of the course can find out more on their own.

No two people learn in exactly the same way

Designers often fall into the trap of referring to “the learner” as if there is only one learner or that all learners are clones of the same learner. Such thinking can lead you to oversimplify your approach by assuming that all learners are alike. Not only are learners rarely the same, they vary in their attitudes and abilities from hour to hour or even minute to minute.
Learning styles, preferences, and abilities vary

Learners vary in the ways they attempt to learn material and in the ways they are most effective in learning material.

Some learners are primarily verbal while others are highly visual. In his book *Frames of Mind*, Harvard psychologist Howard Gardner identifies seven “intelligences” through which people learn and think. These include linguistic, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, intrapersonal, and musical.

Learners also vary in how they assemble new knowledge. Some benefit from a bottom-up approach, learning small pieces and then assembling them into larger and larger units of knowledge. Others absolutely insist on a top-down approach, starting with a big-picture preview of the whole before considering any of the details.

Some learners prefer to begin with abstractions and then view examples of how they apply to specific cases. Others prefer the opposite approach, starting with concrete examples and discovering the general principles for themselves.

In addition, as mentioned in the section, Learning about learners, differences in language skills, visual and hearing impairments, and varying levels of computer skills profoundly affect how well people can learn from a particular medium or technology.

Design for various learning styles

If you are teaching a homogenous group of learners, design for the mainstream preferences and common abilities of that group. Suggest a path through the material, but do not restrict learners to this path. Through menus, course maps, hypertext links, and an alphabetical index, let learners locate and learn exactly what they want to learn.

Let learners choose how to learn

Often the best approach is to let learners choose how to learn. Provide the same material in different forms and let learners select the form that best meets their needs. For example, you may want to offer learners a choice between listening to voice narration or reading a text transcript of the narration—or doing both.

Include more than simple Next buttons in your navigation. Include a hierarchical menu and even an alphabetical index. By providing a rich navigation model, you enable learners to take the course in a sequential, top-down, bottom-up, or exploratory order. Provide tools for learners to measure their progress against their own goals.
Let learners set the pace

Do not shackle adult learners to a rigid schedule. Busy adults may find it hard to keep up; and impatient ones may not want to wait. Design your course so that learners can progress as rapidly or as deliberately as they see fit.

Design your course so that learners can quit as soon as they meet their objectives. Do not imply that quitting early indicates failure. Provide summaries so those who do not complete the entire course can get a glimpse of what they are missing. Encourage learners to come back any time they want a refresher or just to explore more details. Make learning a continual process, not a one-time event.

Simplify learning activities to match learners’ computer skills

Do not overwhelm learners with new technology. As a rule, do not require learners to master more than one new technology at a time. If learners’ skills are limited to surfing the Web and sending e-mail, you probably do not want to require them to download and install three player programs, hook up a microphone and video camera, and engage in videoconferences all during the first module of the course.

People learn what they notice

It should come as no surprise that people learn more from things they notice and attend to than from ones they ignore or are unaware of. Focus your designs on the material to be learned and exclude irrelevant material.

Attention can improve learning

Attention is like a flashlight in a dark room. We observe the details of objects in the bright beam but notice less about objects in the dim shadows. The more time people spend considering an object the more likely they are to learn about it.

Distractions hinder learning

Noise, interruptions, and distractions can interfere with learning, as anyone knows who has tried to study with unwanted loud music playing. Anything that disrupts thought processes or draws attention away from the material being taught can hinder learning. Placing a twirling 3D logo in the upper corner of every page may seem like a good idea—until you observe how many learners try to cover it up so they can pay attention to the information on the page.
Focus attention on what you are teaching
Explicitly tell learners what is important and why. Use motion, bright colors, loud sounds, stark contrast, larger size, arrows, and other emphasis mechanisms to focus the learner's attention on the material you are teaching. Conversely, use static shapes, cooler colors, low contrast, and small size for secondary or purely decorative items.

Leverage consistency
Use a consistent visual design so that routine items occur in predictable locations and colors. That way you do not need to emphasize them to ensure that learners find them.

Practice perfects learning
When it comes to learning, practice makes perfect—or, at least, it perfects and deepens prior learning.

Repeated practice improves recall
Repeated practice is a useful way to make the recall of facts faster and more reliable. Remember the flash cards used to teach multiplication tables or a foreign language vocabulary?

Practice consolidates complex activities
Practice also helps us consolidate complex activities so that they can be performed smoothly and spontaneously. Only by repeatedly speaking in a foreign language do we progress from hesitantly uttering individual words to fluently discussing complex issues. Only by practicing the individual steps of a dance movement do we begin to integrate them into smooth, graceful movements.

Let learners apply knowledge and skills immediately
Let learners practice newly learned material as soon as practical. Immediate practice helps to reinforce learning. It also rewards learners with a sense of accomplishment and lets them monitor their own progress.
Let learners determine the amount of practice

Provide lots of opportunities for practice and let learners decide how much is enough. Some learners may master a skill or concept immediately. Others may need more practice. Some may want only a cursory ability while others may want to perfect their abilities before moving on. Rather than specify how much to practice, specify the level of performance to achieve. For example, “Repeat the game until you achieve a score of 60 points or higher.”

Make practice exercises authentic

To the extent possible, make the practice in the course similar to applying the skill in the real world. It’s important that the practice exercises the same mental processes as the real-world application. A highly realistic visual simulation of real-world situations helps, but is not the most important factor and not absolutely necessary.

For example, suppose you are teaching supervisors how to screen resumes. It is more important that the resumes contain the same kinds of information as real resumes than that the supervisor have to use a virtual letter opener to pry open the flap on a virtual-reality envelope and extract the resume from the envelope.

Deeper thinking produces deeper learning

Shallow observation and thinking leads to shallow learning—or no learning at all. We must ensure that learners think deeply in order to learn well.

Levels of processing vary

We can process information in various ways. Consider the levels of mental processing required to answer each of these questions: What is the first letter of the word banana? What color is a banana? Do bananas grow wild in Canada?

The first questions requires no real thought at all, just observation. The second requires that you imagine a banana and visually examine its skin. The third requires recalling and logically comparing related facts about bananas and Canada. Which question do you think you will remember tomorrow?

Learning comes from establishing associations

Human memory is highly associative, with thought linked to thought, memory to memory. Quickly recall your associations to the color green. List other colors. List some green objects. List slang meanings of the word green. See how many associations you have to this one concept?
Associations help us recall and understand items. The more associations we have for an item, the more ways we have to trigger its recall. What words can be used to fill in these blanks: ______ as a beet. The Kremlin is on ______ Square. Stop on ________; go on green.

Such associations are essential clues to the meaning and importance of an idea. Consider the word set. It has one meaning in a mathematics classroom, another at the bridal registry at Tiffany’s, and still another on the tennis court at Wimbledon. Unless we know the context, we do not know the meaning of words and ideas.

**Provoke deep thinking not shallow clicking**

Much “hands-on” learning is unfortunately “brains-off” learning. Many activities require little more than a modicum of eye-hand coordination. For effective learning, design activities that require learners to think about the material.

- Require analytical thinking to complete activities and pass tests. Rewrite questions that can be answered by process of elimination or by parroting back words read earlier. In multiple-choice questions, provide at least four plausible answers.
- Require learners to apply knowledge. Present realistic situations in which learners must specify how they would apply what they learned.
- Require combining separately taught ideas. Require learners to compare, contrast, and integrate separate ideas.

**Build rich associations**

Help learners connect ideas so they are easier to recall and their context is clear.

- Relate new ideas to old when introducing new ideas. Remind learners of related ideas they learned earlier and show how the new ideas extend or contrast with the older ones.
- Present multiple examples and show more than one version of an idea. Try to include enough examples and non-examples so that learners recognize the essence and limits of the idea and see how many ways it can be applied.
- Encourage learners to explore an idea from different perspectives. Let learners examine a single idea, then in context with related ideas, and as a part of a larger whole. Help learners understand the idea in the abstract as well as embodied in concrete examples.

**Human information-processing is finite**

Homo sapiens has not had a processor or memory upgrade in about 50,000 years. Although the human brain can do wonders, its capacity and endurance are not infinite. These limitations affect the ability of our species to learn.
Perception and memory are limited

The limitations of human perception, memory and attention are mercilessly well documented. Here are the most important limitations that you, as an instructional designer, must keep foremost in your limited memory:

• Visual perception is limited to six or seven items.
  We can take in only about a half dozen objects at a glance. More than that and we have to laboriously examine them one at a time or in small groups.

• Working memory is limited to about seven items.
  Try remembering a list of more than a few items and you quickly run into the limits of human working memory.

• Working memory is short term.
  Try recalling a new phone number for more than about 20 seconds, without continually repeating the number to refresh your memory.

These limitations mean that human beings can only process a relatively small amount of information at a time.

Teach in bite-sized chunks

Keep your presentations simple, short, and to the point. Remember how easy it is to overload learners. A geyser of facts and images may dazzle the learner without teaching anything.

Rather than long lessons, teach in a series of micro-lessons, each conveying a single concept, skill, or fact. After presenting a concept, immediately let learners practice applying the concept and verify that they understand it. (An increasingly common term for such small, complete units is learning objects.)

Keep presentations simple

The more complex the subject you are teaching, the more you need to simplify your presentation.

• Eliminate unnecessary material. Delete material unnecessary to make your point. Move secondary information, needed by only a small fraction of your learners to a deeper layer or subsequent page.

• Limit the number of items the learner must contend with. Keep lists short. Divide the display into only a few main areas, each with only a few objects.

• Simplify text and graphics. When possible, use shorter paragraphs and lists. Employ only as many colors, shapes, and other objects as necessary.
Offer just-in-time training

Instead of teaching people information ahead of time, consider providing just-in-time, just-enough training that lets learners look up only the information they need at the moment they need it. Consider the following training forms: job aids, best practices, glossaries, frequently asked questions (FAQs) files, and search engines.

Teaching specific subjects

This section will help you decide what kind of presentations and practices to use when teaching various kinds of information. Each subsection includes a brief table that suggests what information to present and what activities to use to test the learner’s knowledge in practical applications. Use these suggestions as a starting point and remember to include other required components such as introduction, motivation, and summary as well.

Facts

Facts include names, dates, numbers, and other specific nuggets of information. Learning a fact means that you can recall it at will and that you understand its importance and implications.

Concepts include abstract principles, general methods, and mathematical theorems. Learning a concept means not only being able to recite an idea, but also understanding how to apply it in an appropriate situation. The following table suggests ways to present concepts and ways to test the learners’ understanding of them:

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement or definition of the concept in words, pictures, rules, formulas, or other media.</td>
<td>Recognize the concept. Test whether learners can recognize examples and non-examples of the concept.</td>
</tr>
<tr>
<td>Instances of the concept. Descriptions, pictures, or stories that illustrate the concept. Include borderline examples and near-miss non-examples too.</td>
<td>Recall the concept. Test whether learners can state the concept in their own words.</td>
</tr>
<tr>
<td>Implications. Statement of what the concept means and why it is important.</td>
<td>Apply the concept. Test that learners can specify whether and how to apply the concept in specific real-world scenarios.</td>
</tr>
<tr>
<td>Analogous concepts. Remind learners of related concepts and explicitly state the relationship between the concepts.</td>
<td></td>
</tr>
</tbody>
</table>
Procedures

Procedures are related sequences of actions that answer the question “How do I do X?” If your goal is to enable the learner to perform a procedure only one time, you can simply display a concise list of steps and make sure learners know where to find the list again.

On the other hand, if your goal is to enable the person to perform the procedure from memory in the future, consider these presentation and practice components:

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose of the procedure. Description or picture of what the procedure does.</td>
<td>Recall steps. Have learners fill in blanks to show they remember steps, click in pictures to point out where steps are performed, and drag objects to put steps in the proper order.</td>
</tr>
<tr>
<td>Steps of the procedure. A numbered list, picture sequence, animation or video clip of the actions to perform.</td>
<td>Perform the procedure. Have the learner perform the procedure with a real or simulated system, first with instructions and then from memory.</td>
</tr>
<tr>
<td>Decision aids. Checklists, flowcharts, and decision-tree diagrams to aid in deciding which actions to perform.</td>
<td></td>
</tr>
<tr>
<td>Required components. Worksheets and forms to fill in as part of the procedure.</td>
<td></td>
</tr>
</tbody>
</table>

Cognitive skills

Cognitive skills involve working with knowledge. Though they may also involve some physical activity, the most difficult part of a cognitive activity is in recalling, weighing, organizing, and deciding upon facts, making strategic judgments, defining goals and constructing strategies to carry them out.

Cognitive skills may include mastery of facts, concepts, and procedures. Once learners are familiar with the facts, concepts, and specific procedures, learning cognitive skills then requires integrating these lower-level skills with additional decision-making abilities.
The table below suggests some presentation and practice components for teaching cognitive skills:

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case studies. Rich, appropriately complex examples showing application of the skill being taught.</td>
<td>Knowledge of component skills. Test learners’ ability to apply the component parts of the skill. Do they have the required knowledge, decision-making ability, or procedural skill?</td>
</tr>
<tr>
<td>Guidelines. General rules that aid in making decisions. Each principle will require examples and non-examples.</td>
<td>Application to simple cases. Test learners’ ability to make decisions and judgments regarding applying the skill to simple scenarios.</td>
</tr>
<tr>
<td>Decision aids. Decision trees, decision tables, flowcharts, and checklists.</td>
<td>Application to complex cases. Include realistic case studies and require learners to specify in detail how they would apply the skill in each case.</td>
</tr>
<tr>
<td>Prerequisite material. Hypertext links to the modules that teach the lower-level facts, concepts, procedures, skills, belief, attitudes required by this cognitive skill.</td>
<td></td>
</tr>
</tbody>
</table>

**Psychomotor skills**

Psychomotor skills involve deft manipulation of the human body. Psychomotor skills include dance, typing, physical therapy, and just about every form of athletic competition imaginable. Motions must be performed smoothly without conscious control of each individual movement.

Of all the areas of training, psychomotor skills are the most difficult to teach online. The fundamental problem is providing meaningful feedback to the learner. How can the computer monitor muscle movements and timings so subtle that even experienced coaches sometimes miss them?
Because of these limitations, online training cannot teach psychomotor skills perfectly or completely. You can use online training, however, to introduce such a skill, thereby making the in-person training less expensive and more efficient. Here are some suggestions:

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill demonstration. Use video, animation, virtual reality, or picture sequences of the skill with commentary on critical movements and timings as well as tactile feedback (“... until you feel a warm sensation at the side of the neck.”) Include a few bad examples pointing out common mistakes.</td>
<td>Exercise of simple movements. Have learners practice simple individual movements that do not require feedback from another person.</td>
</tr>
<tr>
<td>Instructions on the basic movements. Teach the simple component movements that must later be combined.</td>
<td>Practice the location and sequence of movements by clicking in a picture or by simulating in virtual reality.</td>
</tr>
<tr>
<td>Basic knowledge. Include or link to prerequisite or subordinate facts, concepts, and procedures.</td>
<td>Follow along to a video or animation clip of the skill being applied. Use voice-activation to pause and resume the playback.</td>
</tr>
<tr>
<td></td>
<td>Prescribe and track a practice regimen. Have learners enter practice completion results into database that tracks their progress and sends e-mail reminders and encouragement.</td>
</tr>
</tbody>
</table>

**Attitude**

Attitudes guide behavior. Human beings interpret and react to the world through habitual ways. Often misunderstandings, biases, and prejudices prevent people from achieving their goals. Thus trainers must frequently work to change learners’ attitudes. Perhaps you want to replace a defensive, a critical attitude with a more open, supporting one. Or perhaps you need to replace an attitude of naïve acceptance with alert caution.
The following presentations and practices can effect a change of attitude:

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stories. Include first-person stories (in video, audio, or text) of incidents where individuals profited from the desired attitude or suffered from its lack. Choose stories learners will recognize and identify with.</td>
<td>Test attitudes. Ask questions that indirectly reveal the learner’s biases and prejudices on a subject.</td>
</tr>
<tr>
<td>Case studies. Present instances (in text and picture or in video) showing the effects of attitude change.</td>
<td>Apply to situations. Present “What would you do in this case?” scenarios that monitor how the learner interprets and reacts to situations.</td>
</tr>
<tr>
<td>Statistics. Include research findings (tables or charts) documenting the effect of an attitude change.</td>
<td>Simulate human interaction. Let learners directly experience the consequences of their own attitudes. Style the simulation as a game that the learner can win only by exhibiting the desired attitudes.</td>
</tr>
<tr>
<td>Humor. Use cartoons or humorous stories showing in an exaggerated way the consequences of good and bad attitudes.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Tinkering with someone’s interior belief system may seem like brainwashing at worst or propaganda at best. True, there are vast opportunities for ethical blunders, but failing to confront an attitudinal barrier can be counterproductive to helping learners achieve their goals.

**Complex subjects**

How does an emergency room physician decide the best treatment for a patient with multiple life-threatening injuries? How does a corporate executive plan the merger of marketing and sales departments? How does a parent teach a child to resist peer pressure?

Some subjects are so complex they seem to defy any definite instructional strategy. Usually these are areas that interweave specific facts and procedures with vague concepts and attitudes. These are typically fields with few right answers, where even successful experts cannot describe their decision-making process and credit intuition or instinct for much of their success.

Prescribing definite presentations and practices isn't possible for these complex situations, but you can apply the following general strategy:

- Simulate real complexity.

Immerse learners in a simulation that, like the real situation, requires making decisions based on incomplete and sometimes misleading information. You can style the simulation as a pretend environment, a learning game, or as a role-playing activity.
• Involve people.
  Computer simulations have their limits when it comes to mimicking human interaction. Chat sessions and discussion groups may be necessary to make interaction resemble the richness of the real world.

• Teach component skills.
  Make sure learners have mastered all the required skills, know all the required facts, and exhibit the best possible attitudes.

• Provide decision aids.
  Supply online checklists, decision tables, and wizards to help learners perform the routine decisions.

**Presentation design**

Presentation design deals with the appearance of the display. A few years ago, presentation design dealt with just visual elements—layout and legibility—but today it includes the use of multimedia components such as audio, video, and interactive elements.

**Design goals**

An online training course is not a sales catalog, a newspaper, a movie poster, or a novel. The presentation design for online training must accomplish the goals of your specific learning task. In general, design your display with these goals in mind.

• Focus attention on what you are teaching.
  Emphasize primary information and make it easy to find.

• Avoid visual fatigue.
  Learners may have to look at hundreds of pages. Choose designs that are simple and do not easily tire the eyes and mind.

• Design for scanning.
  Learners skim, scan, and skip before settling down to read. Design so that learners can find an individual item of interest quickly and reliably.

• Design to educate, not to impress.
  Learners who have seen the latest Hollywood special effects and played the latest video games may not be impressed by a simple multimedia course. But they can learn a great deal if you design it correctly.
Layout for efficient learning

Divide the page into a large primary content area in the center and a few secondary areas around the edge for banners, navigation buttons, and secondary content. Distinguish areas with different color backgrounds or borders, or just by the alignment of objects within the areas.

Here is an example that divides the display into four main areas:

The area at the bottom is reserved for the main navigation and course services (map, glossary, discussion group, and so on) buttons. The area to the left contains the secondary navigational aids such as the table of contents, the index, and the search facility. The large area to the right is the main presentation area. In this example, the course syllabus is displayed in this area.

The most prominent heading is the banner heading, with the course title. Other headings are deliberately less prominent.

Once you have established these zones, use them consistently. Standardize the location of banners, titles, location indicators, navigation buttons, and any other items common to many pages.
Keep text legible

Use style sheets or other mechanisms to ensure that all body text is legible. In general, follow these guidelines for paragraphs of regular text.

**Adequate type size.** In general, use a 10-point or larger type font. In HTML documents, use only type size 2 and larger.

**High background contrast.** Make sure the text stands out from the background. Avoid fussy backgrounds and backgrounds that are similar in color and brightness to the text.

**Minimal emphasis mechanisms.** Within a paragraph, use only a few variations of font, style, or color. It’s OK to emphasize a word or two, but not every third word and not the whole paragraph.

**Left-aligned text.** Avoid centered or right aligned text except for short passages and then only for a special effect.

**Short line length.** Keep lines of text 40-60 characters in length.

**Adequate line spacing.** Space lines of text about 1/30 the length of a line.

**Uppercase and lowercase.** Do not use ALL UPPERCASE for an entire paragraph.

**Simple character shape.** Prefer fonts with simple letter shapes. Avoid decorative and highly stylized fonts. For screen display, a simple sans serif font works well.

Tear down the great wall of text

If your course includes long passages of plain text, consider how many people will have the visual stamina to read the whole block. Here are some tips to make long passages more readable.

- Edit the text. Can you say just as much with fewer words?
- Convert long paragraphs to lists. Use bullet lists for choices, numbered lists for procedures and rankings, and checklists for items to consider.
- Use tables, charts, and diagrams. Graphical forms work better for conveying complex trends, patterns, and relationships at a glance.
- Use multimedia for dynamic subjects. Consider animation or video. If a speaker’s tone of voice is important, use voice narration.
Highlight important items

Layer your display. Make the most important items the easiest to spot. Make secondary items legible, but do not let them steal attention from the ones learners should see first.

Use these emphasis mechanisms... ...To highlight these kinds of information

Motion and blinking Safety warnings and cautions
Sound and voice Titles
Bright, warm colors Headings and other scanning targets
High contrast or intensity Critical information, especially facts and figures the learner might not expect
Larger size Key items you want the learner to notice
Distinctive type style

Consider the following cautions when designing your course interface:

• Use the most powerful emphasis mechanisms most sparingly and only for the most important information.

• Emphasize through contrast.

  If most of your display uses hot, bright colors, items in cool, muted colors will stand out.

• Preserve legibility.

  It is impossible to read text or view details in moving or blinking objects. Using bright colors for text can reduce foreground-background contrast.

• Put critical information in the first scrolling zone.

  The size of that scrolling zone depends on the size of the browser window as determined by the learner, not the designer.
Put content in context

In online training, learners may jump around within a course, taking topics in the sequence that best suits their needs and preferences. Therefore, designers must ensure that when learners arrive at a page they clearly see how it fits into the overall learning program. Here are some suggestions for keeping your context clear:

• Title pages clearly.

  Ensure that the title (and main heading) make sense alone. Avoid titles that assume learners read some “previous” topic. Also avoid cute titles that are explained only by reading the text of the page.

• Introduce the subject.

  Include a brief introduction, just a sentence or two to explain why the subject of the page is important and how it relates to other subjects.

• Include where-am-I cues.

  Large Web sites frequently show the path from the top menu to the current topic, something like this: “Overview > Getting started > Step 1.”

Summary

Develop your online training course systematically. Follow a deliberate process and apply principles of effective learning to your design.

• Anchor your training efforts in the business goals of your organization. Let business goals decide who needs training in what subjects.

• Research your learners thoroughly. Design for their needs, goals, and capabilities.

• Develop through a cyclical process of four steps: analyze, design, build, and evaluate. At the end of each cycle, decide how to improve your course and begin again.

• Design top-down, successively decomposing general learning goals into more specific goals until each goal can be taught by a single learning experience.

• Design for e-learning, not the classroom. Explicitly motivate lonely distant learners. Keep learners active with lots of opportunities to apply what they are learning. Let learners control the pace and path of the course.

• Lay out the display to focus attention on the most important material in the display and to avoid unnecessary distractions.

• Keep text and crucial details legible, so that learners can easily navigate and read your course.
Resources

Online courses and tutorials
Instructional Design for the New Media
(www.rcc.ryerson.ca/learnontario/idnm/index.html)
Instructional Design Methodologies and Techniques
(www.seas.gwu.edu/~tlooms/ISD/isd_homepage.html)

Web sites
Explorations in Learning & Instruction: The Theory into Practice Database
(www.gwu.edu/~tip/)
Instructional Design Resources
(www.wisc.edu/learntech/design/id.htm)
Principles of Instructional Design
(dl.wju.edu/e472instrdesignres.htm)

Books

Software
Designer’s Edge®, software for planning and designing training, by Allen Communications (www.allencomm.com/software/designer/)
Forms for planning all phases of instructional design and development, by William Horton Consulting (www.designingwbt.com/html/designforms.htm)
Author biography

William Horton is author of *Designing Web-Based Training* and creator of www.DesigningWBT.com. He is president of William Horton Consulting, Inc., which guides organizations moving from old to new media and technologies. William Horton has also authored books and other works about training and information architecture, including *The Web Page Design Cookbook*, *Designing and Writing Online Documentation*, *The Icon Book*, and *Secrets of User-Seductive Documents*. He is a graduate of MIT, a registered professional engineer, and fellow of the Society for Technical Communication.
CHAPTER 4
Converting Traditional Courses to E-learning

by William Horton, president, William Horton Consulting, Inc.

If you want to convert your classroom training to e-learning, there are a few things you should consider before charging ahead. First, what is e-learning and is it right for your course, your organization, and your learners? What are the costs, technologies, and other resources required to convert your course? How will you convert classroom learning materials and experiences to successful online experiences? This chapter answers these questions, identifies common pitfalls in the conversion process, and guides you through all aspects of this process.

How is e-learning different?

Using e-learning differs from traditional training in three main ways:

- An e-learning course is delivered on a computer giving learners the flexibility to take the course from the workstation on their desks or from a laptop and cellular modem at the beach.

- An e-learning application is delivered on demand rather than on a specific schedule, so learners can take the course at their own pace.

- Learners lead—learners create their own learning experiences, with the help of the online materials you have created. Learners select which parts of the material to study and in which order.

Of course other models are possible. Web-conducted classroom courses, for example, use videoconferencing and other software to allow distant learners to attend a conventionally conducted classroom course. Some on-demand Web courses may have a facilitator who interacts frequently with individual and group learners.
Should you convert to e-learning?

Before you begin saving your slides as HTML and digitizing the instructor’s melodious lectures, take a few minutes to tally the costs and benefits of making such a conversion. To do so, you must consider the viewpoints of both the training producer and the learner. Unless the advantages of e-learning outweigh the disadvantages for both producer and learner, converting to e-learning may not be an efficient solution.

Producer’s viewpoint

The training producer is the organization that creates and offers the e-learning. That may be your department if you offer training internally or your entire company if you sell training to others. Let’s compare the advantages and the disadvantages for the producer of converting classroom training to e-learning.

<table>
<thead>
<tr>
<th>Advantages for the Producer</th>
<th>Disadvantages for the Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower delivery costs. Once developed, an e-learning course can teach 1000 learners at little more cost than teaching 10.</td>
<td>Costs more to develop. e-learning is new and requires technical specialists to create. Developing e-learning may cost 4 to 10 times as much as an equivalent classroom course.</td>
</tr>
<tr>
<td>Faster training. e-learning can be used to quickly train large numbers of learners. It is not constrained by the number of available instructors or classrooms.</td>
<td>Requires new skills. People who are superb at delivering information in the classroom are not necessarily qualified to design and create e-learning. Producers may need to retrain some staff members and find new jobs for others.</td>
</tr>
<tr>
<td>Fewer facilities. The servers and software required to offer e-learning are considerably less expensive than classrooms, white boards, desks, chairs, and other physical assets.</td>
<td>Has yet to demonstrate its value. Customers who understand the value of three days of classroom training may balk at paying the same price for even more effective learning delivered online. e-learning must clearly demonstrate a strong return on investment.</td>
</tr>
<tr>
<td>No travel for instructors or learners. Instructors no longer have to travel to distant training centers or client sites to conduct classes.</td>
<td>Requires redesign. The lack of high-speed connections by learners may require producers to redesign courses to work within such restrictions.</td>
</tr>
<tr>
<td>Accumulated intellectual capital. e-learning captures knowledge that existed only in the head of the instructor and makes it easier to refine and reuse.</td>
<td></td>
</tr>
</tbody>
</table>

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Learner's viewpoint

The person or organization that receives training must feel that it is worth the cost. The table below compares the advantages and disadvantages for the learner when going from the classroom to e-learning.

<table>
<thead>
<tr>
<th>Advantages for the Learner</th>
<th>Disadvantages for the Learner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning anytime, anywhere. Learners can take training right where they are just when they need it. They do not have to wait for a class to start.</td>
<td>Intimidating technology. Many learners new to e-learning find getting started confusing and frustrating. Before they can begin learning, they must master new technical skills.</td>
</tr>
<tr>
<td>Less travel and time off the job. Learners save the cost of travel to the site of training and can more easily fit training within their existing work schedules.</td>
<td>Costs of technology. To take e-learning, learners may have to turbo charge their computers, download and install plug-ins, and expedite their network connections.</td>
</tr>
<tr>
<td>Self-paced, self-directed learning. Learners study only what they need to know. They can skip, skim, and repeat as necessary to learn as much and as fast as they want to. Such self-customized learning is highly efficient.</td>
<td>Learning can be lonely. Some learners miss the informal social interaction and face-to-face contact of classroom training.</td>
</tr>
<tr>
<td>Increased accessibility. Properly designed e-learning is more accessible to those with vision or hearing disabilities, those who learn in a second language, and those with certain learning disabilities like dyslexia.</td>
<td>More self-discipline required. e-learning requires learners to take more responsibility for their own learning. Some find it difficult to establish and stick with a learning schedule.</td>
</tr>
<tr>
<td>Authentic Practice. Designers can create highly realistic simulations. Many online learners prefer the ability to review and practice &quot;with no one looking or keeping score.&quot;</td>
<td></td>
</tr>
</tbody>
</table>

These advantages and disadvantages are not inevitable. With good design, you can overcome most of the disadvantages. Without good design and careful development, none of the advantages are realized. For example, unless lessons have clear menus and predictable navigation, self-directed learning remains an unrealized promise. Conversely, the risk of loneliness may be overcome by the use of online discussions and chat.
Common pitfalls of converting to e-learning

You’re almost ready to begin converting your course—be aware of the following conversion pitfalls.

Replicating classroom training

Often, through impatience, naiveté, or just plain laziness, designers convert their classroom course by simply imitating it. The result may be simply using the Web to conduct a conventional training course at a distance. Or the result may deliver a virtual videotape of the class. The conversion result may consist merely of slide presentations and manuals from the course with none of the interactivity and interaction of the classroom setting. Such mimicry usually delivers the weaknesses of both online and classroom training with none of their strengths.

Doing too much too soon

An overly ambitious effort may send learners into cyber-shock and accountants into financial panic. Abrupt all-at-once efforts frequently thrust too much technology at learners and pressure course designers to use online media for all subjects and activities—regardless of the practical limits of the technology or the stamina of learners.

Blind faith in technology or vendors

Often vendors of technology, tradeshow banners, and magazine ads promise easy, instant results: “Your course online in 15 minutes.” Just pour your content into our system and, voilà, learning occurs. This is hardly the case. Effective programs of instruction require careful analysis, design, and construction, regardless of the medium of delivery.

Managing the conversion process

Once you have decided that e-learning is the solution you want, you are ready to begin the conversion process. Converting a traditional course to e-learning is a complex endeavor and you must follow a systematic methodology to make the conversion economical and effective.

This conversion process involves several related phases, which we’ll discuss in this chapter. For information on the instructional design process of developing courses see Chapter 3, “Instructional Design for E-learning” on page 69
Setting goals

The goals for your online course need not be the same as those for the classroom course. Review your original goals against results from the classroom course. Are there some goals you have been unable to achieve in the classroom? Can online technologies allow you to achieve those goals? Can e-learning enable you to reach different learners? That is, can the online version accomplish objectives that are impossible or uneconomical with classroom training? Conversely, will limitations of the online medium, such as lack of face-to-face contact, restrict what the online course can accomplish? Be realistic and fine-tune your ambitions.

Reanalyzing learners

To design your classroom course, you probably studied the background knowledge, job requirements, and other characteristics of the anticipated learners. When you begin converting that course to an online form, you will need to reassess your learners to acquire additional information about them.

The learners for your online course may be quite different than the ones who show up for your classroom course. Because the learners control their e-learning session, the abilities and biases of learners are paramount to the success of your project. For more information about what kind of knowledge you need to gather about your learners, see Chapter 3, “Instructional Design for E-learning” on page 69.

Specifying the course

The next step is to describe the lessons, sections, topics, activities, practices, and other aspects of the course in enough detail that developers can create them later.

Converting materials

Tasks involved in converting materials range from the simple and routine to the complex and creative. For each learning experience in the classroom course, such as a hands-on computer exercise or a role-playing activity, you will need to decide how to trigger the same experience in remote learners. For more information, see “Converting specific assets” on page 111.

You may also want to invest in creating templates and other reusable components that will speed the conversion of common types of materials.

Evaluating a prototype

Once you have created a pilot version of your course—perhaps before it is even complete—test it with actual learners. Measure not just their subjective reactions to the course but whether they met their goals in taking the course and how well they can apply what they learned.
Redesign based on feedback

Gather your team and consider the results so far. Is the course working for learners? Is the production process efficient? Is the resulting course something you can be proud of? Identify concrete ways you can improve the course and streamline your production process. Keep revising until everything works smoothly.

Assembling a multitalented team

Creating an e-learning application takes a wide range of talents and skills. Before you begin the process, make sure you have access to the necessary human resources.

The following sections describe the skill categories required to create an online course. If this list seems long it is only because the process of creating e-learning is complex. Later we will suggest ways to find the necessary skills.

Project management

Complex projects like developing an e-learning course require proper monitoring and control. A project manager, typically the team leader, must schedule and budget the project, coordinate the activities of separate specialists, and set standards for the project as a whole.

Project management requires good administrative skills combined with a broad, but not necessarily deep, knowledge of the subject matter of the course and the technologies used to deliver it.

Courseware development

The central chore of any course conversion involves creating the components that present information and interact with learners. This task can require a wide range of skills, depending on how sophisticated your courseware is and how ambitious your goals are. Courseware development requires a range of technical skills:

- Using sophisticated authoring software for constructing courseware by pointing, clicking, and dragging requires knowledge to translate the project goals into specific pages and activities.

- Creating templates and reusable objects is a task for senior designers, who then guide and streamline the work of other designers.

Such senior designers must master the advanced features of authoring software that enable creating such components.
• Using and writing behaviors.

Many authoring products come with built-in behaviors to provide interactivity with learners. Creating more sophisticated custom behaviors may require some programming skills in JavaScript or Lingo, for instance.

• Creating and including applets and controls.

Most authoring software allows designers to embed custom extensions such as Java applets or ActiveX controls (for Windows systems) into their creations. You can draw from the many applets and controls available for free or a small licensing fee or, if you have the programming skills, you may choose to develop your own applets and controls.

**Instructional design**

Although you may preserve some aspects of the instructional design of the original course, getting the most from the conversion process may require designing new types of learning experiences. In addition, designing e-learning is like designing a computer program that will require the same attention to ease-of-use and reliability as does a spreadsheet or word processor. If you do not have an instructional designer on the team, see the principles and procedures in Chapter 3, “Instructional Design for E-learning” on page 69.

**Technology integration**

Creating e-learning usually requires combining several separate products and technologies. This effort requires someone who can identify the needed technologies, select products to implement them, and get the selected products and systems working together. Such people often reside in the information technology department and have titles like “systems engineer” or “information systems architect.”

This job requires the ability to translate the needs and concerns of other team members into technical requirements for selecting products.

**Visual design**

Creating e-learning projects may require a visual design specialist to design page layouts, specify colors, design navigation buttons and icons, create logos and other emblems, and to draw the most important graphics for the content. Such a specialist must have a keen design sense as well as mastery of the software for producing high-quality electronic artwork that looks good and downloads quickly.
Multimedia development

If the course includes more than text and static graphics, you will need a multimedia specialist to record and edit audio and video components, create animations, specify visual transitions, and integrate and synchronize all these separate media elements. Such tasks require the ability to conceive complex human interactions and execute them in available technologies.

Configuring the team

The checklist of required skills may seem to suggest a vast committee and enormous payroll but on the contrary, the best way to accomplish effective conversions is with a small core team assisted by available specialists. Consider the following ways to keep your team small but effective:

- Combining the skills of multitalented individuals can supply several of the needed skills. For example, a visual specialist may be able to double as multimedia developer. The person responsible for technology integration may have programming skills that can be used to craft templates and program custom behaviors.

- Borrow specialists. Other projects within your organization may already employ the specialists you need. If your project doesn't need them full-time, perhaps you can borrow these specialists long enough to satisfy your need for their skills.

- If time permits, you may choose to retrain your staff to upgrade their skills. Consider which skills you are missing and which team members could most quickly acquire the needed skills. Look for hidden talents and a willingness to extend existing skills. A Lingo programmer may be able to pick up JavaScript programming quite rapidly if encouraged.

- Employ temporary contractors and consultants. Outside consultants and contractors may have high hourly rates, but if your need for their skills is short-term, they may provide a less expensive alternative than hiring a new staff member or retraining an existing staff member.

Analyzing your existing course

“I already have the conventional course. Why do I need to do a new design?” “Can't I just use the same design in online media?” Not quite. You can convert some of the materials from the classroom course for use in the online version, but differences between the classroom and online course experiences mean that some of the learning situations in the classroom may not translate to the online form. For these you must find substitutes.
Let’s look at the experiences of learners in a typical classroom training class. Think about how each experience contributes to learning and how you can provide the same experience in the online version.

<table>
<thead>
<tr>
<th>Classroom Experience</th>
<th>Implications for the Online Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learners file into the room and find their seats. They chat as they wait for the</td>
<td>The classroom setting provides a familiar environment with clear expectations, where learners know the</td>
</tr>
<tr>
<td>instructor to appear.</td>
<td>rules. For the online course, you may have to spell out the procedures and make the rules explicit.</td>
</tr>
<tr>
<td></td>
<td>The course and each lesson should begin with a welcome screen to motivate and orient learners. Tell</td>
</tr>
<tr>
<td>The instructor arrives and calls the course to order. The instructor welcomes the</td>
<td>learners what they will gain by taking the course or lesson. A menu or course map should point out the</td>
</tr>
<tr>
<td>learners, mentions the subject of today’s class, and specifies the agenda.</td>
<td>structure of the course and each lesson.</td>
</tr>
<tr>
<td></td>
<td>If the online course has a facilitator, enable learners to submit assignments electronically. If there</td>
</tr>
<tr>
<td>The instructor pauses to collect any assignments due from the last class.</td>
<td>is no instructor, you will need to add computer-scored activities to enable learners to monitor their</td>
</tr>
<tr>
<td></td>
<td>progress.</td>
</tr>
<tr>
<td></td>
<td>The slides can be converted to Web pages or to other displays. Animated effects and transitions can be</td>
</tr>
<tr>
<td>The instructor lectures. The instructor’s main points are summarized and illustrated</td>
<td>reproduced in a multimedia program or by Dynamic HTML. The instructor’s narrative may contain the</td>
</tr>
<tr>
<td>on slides or overhead transparencies.</td>
<td>core concepts of the lecture, which must be captured and possibly supplemented with additional</td>
</tr>
<tr>
<td></td>
<td>illustrations.</td>
</tr>
<tr>
<td></td>
<td>Since online learners must monitor their own progress, we must help them by building in plenty of</td>
</tr>
<tr>
<td>At various points, the instructor scans the audience for furrowed brows, rolling</td>
<td>opportunities for them to do so. This may require interleaving lecture segments with short tests and</td>
</tr>
<tr>
<td>eyes, and dozing heads. To wake up the class or test understanding, the instructor</td>
<td>other chances to apply the knowledge presented.</td>
</tr>
<tr>
<td>asks questions of the class.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design the course so that learners can find information on their own. You might include a logically</td>
</tr>
<tr>
<td>At other points in the lecture, raised hands interrupt the instructor’s monologue so</td>
<td>organized menu, an alphabetical list of topics, or links to auxiliary material.</td>
</tr>
<tr>
<td>that learners can ask the instructor to clarify a point or to provide more details.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provide detailed instructions on how to perform the exercises. Be sure to tell learners how to monitor</td>
</tr>
<tr>
<td>After the lecture, the instructor may assign a lab exercise or other hands-on activity</td>
<td>their own success and to get back on track if they fail. If conducting the activity on a real system is</td>
</tr>
<tr>
<td>to let learners apply the concepts covered in the lecture and to verify that they</td>
<td>too dangerous or expensive, employ a simulator to provide equivalent experience.</td>
</tr>
<tr>
<td>understand these concepts.</td>
<td></td>
</tr>
</tbody>
</table>
Use this analysis on your existing course. First, review a videotape of a typical class. Then, watch the tape again with the sound turned off. Finally, just listen to the tape. Identify the learning experiences in the course and decide how you will provide each online.

### Creating effective learning experiences

Merely flinging Web pages, online readings, video clips, and other materials at the learner is not likely to have any positive effect. In designing your online course, you must trigger experiences that produce effective learning.

Instructors talk and learners listen. Instructors use lectures, demonstrations, and stories in the classroom effectively. How can we enable this essential process to take place when the learner is 12 time zones away?

#### Identifying the experiences that teach

Review the list of experiences you have compiled. Identify those experiences that truly teach. Not every experience in classroom training teaches anything. Many occur simply as a result of the limitations of classroom training. Replicating these experiences would only make e-learning less convenient.
Producing equivalent (or better) experiences online

Once you have identified which experiences truly teach, then decide how to create an equivalent or better experience in the online version. Sometimes you can simply recreate the same experience. Other times differences between classroom and e-learning require you to rethink the experience and come up with an online form that, though different from the classroom experience, has the same effect on the learner.

Preserving the strengths of your instructional design

In converting your course, take care to preserve the design strengths of the classroom course. In developing and repeatedly teaching a course, you have probably developed effective ways of explaining difficult concepts. Most important, you have included frequent doses of encouraging feedback for learners. Make sure your online design includes these essential strengths.

Converting specific assets

Once you’ve outlined your new course design, you can begin converting the assets from your classroom course. Assets include anything of educational value: slides, lecture notes, handouts, exercises, and motivational stories. Some conversions may involve simply converting a file format. Others may require you to recreate the asset in an entirely new form. Let’s look at each type of asset you might find in a classroom course and consider how it can be converted.

Video recordings

The simplest way to convert lectures is to videotape the instructor talking, digitize and compress the video, and post the video clip onto a streaming-media server. This may not be the best solution for your particular course, however, especially for learners who lack fast connections or for subjects not easily conveyed by a talking head. In general, reserve video for conveying emotion through facial expressions, gestures, and body language, and for showing how to manipulate three-dimensional objects.

For the video-recordings you decide to use, consider hiring a professional videographer. Make sure the videographer can deliver resulting video in a digital format ready for inclusion in your course.
To shoot your own video:

1 **Rehearse, rehearse, rehearse.**

   Have the instructor run through the material several times. Make sure that any demonstrations can be done without requiring extreme camera movements to follow them. And, make sure that everything will be clearly visible in the small window of video that learners ultimately see.

2 **Light the scene well.**

   Most low- and moderate-cost video cameras capture only a narrow range of light contrast. Position lights to fill dark shadows and reduce unwanted glare.

3 **Put the microphone close to the instructor.**

   Use an external microphone, not the camcorder’s built-in microphone. A lavaliere microphone on the instructor’s collar or lapel works fine. Use earphones on the camcorder to monitor the sound being recorded.

4 **Record smoothly.**

   Capture the scene with a minimum of zooming and panning. Do not be afraid to yell, “Cut!” and start over. Have the instructor pause between segments to make editing easier.

5 **Digitize the video.**

   If you used an analog camera, you will need to digitize your video with an analog capture board. If your digital camera and computer both have an IEEE 1394 interface, you can transfer digital video directly. (IEEE 1394 is called *Firewire* by Apple Computer or *i.LINK* by Sony).

6 **Edit the video.**

   Use a program like Adobe Premier (www.adobe.com) or Ulead’s MediaStudio Pro (www.ulead.com) to splice together the best cuts.

7 **Save the video in a Web-ready format.**

   In saving the video, specify a frame rate, window size, compression settings, and other characteristics to ensure the best quality for learners. If possible, use a streaming format, such as RealVideo (www.real.com), Advanced Streaming Format (www.Microsoft.com), or QuickTime 5 (www.apple.com).

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**Audio sequences**

If watching the instructor talk is not an essential part of the learning experience, you may choose to present just the audio narration. Using audio sequences has several advantages over full video. High-quality audio files are smaller and require much less bandwidth than even poor-quality video. In fact, the combination of high-quality audio and a clear photograph of the instructor may prove more effective than a small, grainy, jerky video window.
Record audio sequences in a professional sound studio to ensure the highest quality recording possible. Be sure to specify that you need the resulting recordings in a digital format.

If you do not have access to a sound studio, you can record your own audio sequence.

**To record an audio file:**

1. **Silence the room.**
   
   Reduce all unnecessary background sound. Close windows. Turn off or unplug all unnecessary electrical and electronic devices, such as computers, telephones, copiers, printers, fax machines, and so forth. If the room has a lot of echo or reverb, throw a rug on the floor or hang a curtain along a wall or two.

2. **Position the microphone.**
   
   Place the microphone close to the speaker’s mouth just outside the breath stream. Usually a lavaliere microphone on a shirt collar works well.

3. **Record digitally.**
   
   Connect the microphone to the sound-in port on a computer equipped to record sound. Remember that some computers require a powered microphone; others do not. Record at the highest quality possible. You can always downsample later.

4. **Edit the recording.**

5. **Using a sound-editing program, select the best attempts. Remove the *uhhs*, *ahhs*, burps, coughs, profanity, and sneezes.**

6. **Save in a compressed format.**
   
   Experiment with various settings to produce a file that learners can download and play smoothly.

**Note:** If you are inserting the sound into a multimedia program like Macromedia’s Flash, Director, or Authorware, that program will take care of the compression.

**Text transcripts**

Text may not seem exciting, but it downloads quickly and even learners with computers lacking sound playback can read text. Even if you do include sound, you may also want to include a text transcript of the instructor’s narrative. A transcription can help learners with hearing difficulties and learners listening in a second language.
**Slide presentations**

Slide presentations are the lifeblood of most training departments—and most of these slides are in Microsoft PowerPoint. Converting slide presentations to the Web will be a large part of the efforts of many training departments for the next few years. Here are some tips on how you can convert such presentations.

**Moving slides to the Web**

To convert classroom slide presentations to components in an online course, you have several options. The appropriate choice depends upon the complexity of your slides and their use of animation, transition, sounds, and other special effects.

**Saving your slide files as HTML**

The simplest solution is to use the Save As HTML command in PowerPoint. In PowerPoint, this command is located on the File menu or as a file type option in the regular Save As dialog box. Selecting this option creates a linked series of Web pages corresponding to the slides in the presentation, and lets you target particular browser levels.

Before you save your slides however, you may want to add extra features. If you intend to include a text transcript, type it as a note on each slide. For voice narration, use the Record Narration command. For instructions, consult the help system in PowerPoint.

**Recording the presentation**

You can record narration or other sounds for playback over the Web from within PowerPoint, using either the built-in capabilities or a third-party program such as RealPresenter (www.real.com).

If you use either of these options, you may still need to separately attach a text transcript of the narration.

**Importing into authoring software**

If you are developing the bulk of your course in another application, such as Macromedia Director or Authorware, you can import the slides or slide text directly into that software.

- For Director, you must first convert your PowerPoint slides to PowerPoint 4 first. Keep in mind that advanced PowerPoint features, such as sophisticated transitions and animations, may not convert.

- For Authorware, you can save the text of the slides as Rich Text Format (RTF) and import it into Authorware. This saves you from having to retype the text.
Recreating slides in another application

If your slides rely on animation and transition effects—or would benefit from such effects—you may find it worthwhile to recreate the slides in a multimedia product and reuse text and art from the original slides.

When importing slides into Flash or Director, you can choose from two methods: the “easy way” or the “better way.” The easy way is faster but leaves you little flexibility to edit the results. The better way takes longer but provides more flexibility to further evolve and improve your results.

• The easy way is to use your screen-capture program to snap a picture of each slide after each element, such as a transition or animation completes, appears. Drop these snapshots into Flash or Director, arranging them in their original sequence, and apply appropriate transitions. If the slides contain voice narration, save the slides as HTML and add the resulting sound (WAV) files to your Flash or Director project. Synchronize the imported sound files with each of the imported pictures.

• The better way is to copy and paste each graphics object from the PowerPoint presentation into Flash or Director. (Alternately you can save the presentation as HTML and then import all the resulting GIF files.) Sequence and animate the objects to match (or improve upon) their appearance in the PowerPoint presentation. Likewise copy and paste the voice narration. You may need to use a sound-editing program to break the narration sequences into shorter pieces to make it easier to synchronize them with the animation.

Reading assignments and handouts

Courses typically have handouts, textbooks, and assigned library readings. All of these readings can be converted to electronic form. Your main choices will be what file format to use and whether to supply the document or create a link to a publicly available copy of the document.

HTML format

Most word processors, spreadsheets, and databases now include commands to save their contents as HTML. By experimenting with the dialog-box options, you can probably obtain files that provide acceptable appearance and layout for your content. There are third-party products, such as WordToWeb (www.solutionsoft.com) and HTMLTransit (www.infoaccess.com) for Microsoft Word, that offer even more control over the conversion process.
Adobe Acrobat PDF

Adobe’s Portable Document Format (PDF) (www.adobe.com) allows you to distribute high-fidelity copies of any documents that can be printed. Creating PDF documents requires the Acrobat publishing software and learners must have the free Acrobat Viewer program to view them.

Acrobat documents can be simple replications of their paper counterparts. Or, you can enhance them by adding hypertext links, a table of contents, thumbnail images of pages, sounds, and other multimedia.

Creating jump pages of related resources

If a course includes lots of readings, you may want to create a single “jump page” that lists them all. Make each list item a link to the actual document. Use jump pages to make finding documents simple. Include all the documents you have converted as well as other publicly available documents of interest to your learners. Here is an example of such a jump page:
Course library database

If the number of documents included in your course grows beyond a hundred or so, or if you are converting a suite of courses in the same general subject area, you may want to set up a database of these related resources. Creating an interface to a Web database is not a task for the under-budgeted or faint of heart. This may be an assignment you want to outsource. Or, you may want to expand your technical skills by using a program like Macromedia Dreamweaver UltraDev.

Tests and quizzes

Learners need frequent opportunities to practice what they are learning. One way to provide these opportunities is to include lots of simple tests, quizzes or exams. Tests can be fun, especially if learners know the scores are not recorded and if the tests are styled as challenging games.

Products like Authorware and CourseBuilder for Dreamweaver make it easy to create standard kinds of tests (true/false, multiple-choice, text-entry) as well as other interactive formats, like drag-and-drop tests. You can create your own unique kinds of tests in products like Dreamweaver, Flash, Director, and Authorware.

If you do need to record test scores, consider an AICC-compliant learning management system. Authorware and CourseBuilder for Dreamweaver test questions can report their scores back to such a system.

Hands-on practice

Many courses include laboratory sessions or other kinds of assignments that let learners practice hands-on activities. To provide equivalent experiences in online courses requires a high degree of interactivity and feedback. Remember that the online version may not need to precisely mimic the classroom activity, but simply exercise the same decision-making processes. Because hands-on activities vary so widely, we cannot provide specific advice on how to implement them. The following examples show where practice solutions might be appropriate.
Coached tasks

Teaching people to use their computers is a high priority within most technical organizations. This example shows a simple way to guide learners through a hands-on task using a series of linked Web pages.

To advance in the procedure, learners must answer a question that tests whether they successfully performed the preceding step.

You can see this example at www.DesigningWBT.com/html/exampleActivityHandson.htm. This kind of activity requires no technology other than plain HTML and a Web browser.
Simulated tasks

Sometimes it is too risky, complex, or expensive to have learners interact with a real system or real people. In this case, you may need to provide a simulation of the real system. This example teaches advanced computer users how to set up a database connection. Because failing at this task could adversely affect existing database access, it is best learned using a simulation.

The simulator is essentially a linked series of image maps of the various dialog boxes in the process. Successfully performing a step, such as clicking on a tab or button, displays the next panel or dialog box in the process.

You can see this example at www.DesigningWBT.com/html/exampleActivityHandson.htm. This activity uses Dynamic HTML and a bit of JavaScript programming. Even richer simulations can be created with products like Director, Authorware, and Flash, which include scripting languages for crafting complex interactions.
Coding laboratory

Activities like programming and coding require lots of hands-on practice. This example provides such practice for people learning HTML.

The Goal panel shows a display format that the learner must duplicate. The learner types in the necessary HTML in the left panel and clicks the downward pointing arrow in the Results panel to see the resulting display and compare it with the target display.

You can see this example at www.designingwbt.com/html/exampleActivityVirtualLab.htm. This activity requires setting up a multiple-frame page and a bit of JavaScript programming to put new content into each frame in response to button clicks. A sophisticated Web-page editor, like Dreamweaver, simplifies the process of creating such framesets and scripting behaviors for them.
Conceptual tasks

Many tasks depend more upon correct decisions than on manipulating physical devices. Here is an example that teaches just such a task. This jigsaw puzzle requires learners to assemble a working computer network by dragging components into place.

As each puzzle piece is dropped into place, the puzzle checks to see whether the piece is at the correct level and whether it is compatible with surrounding pieces. If the piece is not in the correct place, the learner receives a brief explanation of why it is incorrect. In this activity, there is no single right answer; any combination of components that would work in the real world is a correct answer here.

This activity does not require learners to connect cables or insert circuit boards—because those are not the difficulties in the task being taught. It does, however, teach learners how to select appropriate combinations of components.

You can see this example at www.designingwbt.com/html/exampleActivityLearningGameJigsaw.htm. This example was created in Macromedia Director because of the need for the rich programming environment provided by the Lingo scripting language. Dreamweaver, Authorware, and Flash also make good products for creating drag-and-drop games.
Asking questions

One of the most common complaints about e-learning is the difficulty or inability to ask questions. In the classroom, you can raise your hand and wait for the all-knowing instructor to call on you. How can learners in e-learning get answers to their questions?

Menu and course index

Many times the answer to a learner’s question is found elsewhere in the course. The learner is just a bit impatient or may have skimmed earlier material.

One way to enable learners to answer their own questions is to provide a logical set of menus so learners can drill down to a specific topic. Make sure that the menu categories are ones that the learners will recognize. A bit of testing will help you design menus that learners understand.

Another solution goes back five hundred years: include an index in your course. Though this may seem like a radical idea, it makes perfect sense, especially where the goal is just-in-time and just-enough training. An alphabetical list of topics helps learners find the answer to their question, regardless of where the answer may appear in the course. Make sure that the terms in the index are ones learners will recognize, and remember to include enough synonyms.

You may also choose to let learners search for text in your course. Authorware, for instance, lets learners search for words and phrases in the content of a course. If your course is primarily HTML, you will need to employ a Web-site search engine to provide the same capabilities.

FAQ Page

If you can anticipate questions that learners will ask, collect the answers onto a frequently asked questions (FAQ) page and feature it prominently in the course menu. As new questions come in, add their answers to the FAQ page.

E-mail

If the course will have a facilitator, include a button to simplify asking questions by e-mail. Set clear expectations for how soon the learner should expect a reply.

Discussion forums

Discussion groups exist in many forms and are known by many names: newsgroups, e-mailing lists, list servers, computer bulletin boards, and forums. The central idea to all of them is that they enable an ongoing conversation among distant learners, as well as with the instructor or facilitator. Anyone in the group can post a message to the forum and anyone else can read it at their leisure.
Most Internet server software packages include a component to support discussion groups and software to read these groups is often packaged with browsers or e-mail readers.

If you are setting up a discussion group for your course, you may want to consider one of the third-party discussion and chat software packages, such as BuzzPower (www.buzzcompany.com) or O’Reilly WebBoard (webboard.oreilly.com), which allow learners to participate in the discussion right from their Web browser.

**Using chat for office hours**

A chat session, which is like instant e-mail, allows a group of users to carry on a real-time conversation. The message typed by one user is seen by all those in the chat session.

Chat requires chat server software, and a chat plug-in or reader program. Or, you can implement a simple chat system, like this one, using Macromedia Director Multiuser Server:

One common use for chat is for discussions with the course facilitator. The facilitator may announce hours during which he or she will be available to chat. Such online “office hours” provide a way for learners to ask questions and discuss important points with the facilitator.
Using chat for student discussion

Another use for chat sessions is for informal discussions among learners. If learners are at different points in the course, these conversations offer a way for a beginner to find a more advanced learner to answer questions. In any case, such a "student lounge" provides a way to lessen the loneliness of learning at a distance.

Online extras

Your course may include activities outside the classroom. You may distribute job-aids or other reference works in class. The following examples show how you can include extra components in interesting ways.

Virtual museums

In many fields, learning takes place by examining concrete examples. A museum, for instance, is a collection of concrete examples. Students from preschool to post-doc tramp through a physical museum examining and critiquing the milestone works in their fields. You may want to consider creating an online museum to fulfill the same function.
This example of a virtual museum “houses” mineral samples. It provides a photograph and crucial information on each item in the exhibit. You can tour this gallery at www.designingwbt.com/html/exampleBeyondMuseum.htm.

If your museum contains just a few examples, you can create it with a set of well-indexed Web pages or Flash scenes. If your museum grows to include hundreds or thousands of examples, you may need a database to organize them. Dreamweaver UltraDev can help you construct an interface for such a database.

Field trips

Some subjects are best learned by viewing examples in context. A virtual field trip can recreate that experience using rich multimedia or a simple journal page, like this one detailing geological features along the Peak to Peak Highway in Colorado.

You can view this journal at www.designingwbt.com/html/exampleBeyondFieldTripPeaktoPeak.htm.
Calculators

Subject-specific calculators make a great way to simplify the mathematical barriers to learning a subject. They also make an interesting way to keep learners from forgetting about your course. Each time they use the calculator, they are reminded of the course in which they received it.

Here is an example of a calculator used to calculate heat flow through a surface. You can view it at www.designingwbt.com/html/exampleBeyondJobAidsCalculator.htm.

![Heat-flow calculator](image)

Such calculators require some scripting to compute results. Fortunately, Dreamweaver, Flash, Director, and Authorware come with the scripting languages, math functions, and built-in behaviors to create sophisticated calculators.
Glossaries

Not understanding the terminology of a field can hinder learning about it, especially if learners prefer to take the course in the order that suits them rather than the one you expect them to. Providing an online glossary can make technical terminology comprehensible and can relieve you from the burden of defining a term every time you use it.

A simple glossary may consist of a single page listing terms in alphabetical order with their definitions. For more terms, add letter buttons with behaviors that jump to the first term starting with that letter. Even larger glossaries may benefit from the text-search capability of Authorware or the database-interface of Dreamweaver UltraDev.
Job aids

Other kinds of job aids can simplify learning—or even replace lessons. Rather than teaching a task, it might be better to give learners an online job aid that guides them through the task. Job aids can be as simple as a checklist or as sophisticated as an expert system.

This job aid guides supervisors in deciding how to discipline an employee who has violated security regulations. You can view it at www.designingwbt.com/html/exampleBeyondJobAidsConsultant.htm.

Such decision-aids require lots of if-then logic, which can be provided by JavaScript in Dreamweaver or by the scripting languages built into Flash, Director, or Authorware.
Assembling your components into a course

The final step is to integrate your converted components into a complete course. This may involve combining separate HTML pages and creating a table of contents and index over them. Or it may involve importing the components into a “project” file in an authoring program like Authorware, Director or Flash. The exact procedure will depend on the technology choices you make. For information about how to assemble your course content together with other components to deliver a finished course, see Chapter 7, “Deploying Your E-learning Course” on page 171

Summary

With careful design and diligent work you can produce online courses that preserve the strengths of traditional training while adding the benefits of Web technology. Converting traditional courses to effective e-learning takes products, talent, and technique. Here are some points to keep in mind for a successful course conversion

- Convert only if the result will offer more advantages than disadvantages—to both the producer of training and the learner.
- Convert systematically by setting clear goals, re-analyzing learners, specifying how you will convert materials, and converting materials efficiently.

Finally, evaluate a pilot offering of your course and make any adjustments necessary.

- Assemble a small, multitalented team whose skills include project management, instructional design, courseware development, graphic design, multimedia development, and technology integration.
- Deconstruct your classroom course to identify the different learning experiences that take place and decide how to provide equivalent or better experiences in the online version.
Resources

Online
How Classroom Training Can Be Converted for Internet Delivery (itcetera.com/html/demo_intro.htm)

Books

Web resources
Presentation and spreadsheets for calculating ROI (www.designingwbt.com/html/roihandouts.htm)
Filters and conversion programs (www.w3.org/Tools/Word_spec_filters.html)
Articles on converting classroom training to e-learning by Lumin Guild (www.luminguild.com/pubs.htm)

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William Horton is the author of Designing Web-Based Training and the creator of www.DesigningWBT.com. He is president of William Horton Consulting, Inc., which guides organizations moving from old to new media and technologies. William Horton has also authored books and other works in training and information architecture, including The Web-Page Design Cookbook, Designing and Writing Online Documentation, The Icon Book, and Secrets of User-Seductive Documents. He is a graduate of Massachusetts Institute of Technology, a registered professional engineer, and fellow of the Society for Technical Communication.
by Betsy Bruce, consultant, Technology-Based Training

The limitations of the Web present considerable challenges for you as an e-learning course designer. You will need to work within the constraints of a delivery environment that can include unpredictable, low-bandwidth connections and the limitations of browser-based delivery. To succeed at your task of creating an engaging and effective online-learning experience, you need to understand the possibilities and limitations of today’s Web tools and technologies. What media types can you employ for a given delivery environment? What tools do you need? How does available bandwidth affect media usage?

Once you understand what you can do with current technologies, you still need to learn how to get the most out of each one. Strategies for effective media use and optimization tips and tricks are part of every successful course designer’s bag of tricks.

**About bandwidth and multimedia**

To deliver learning applications over the Web, you must first understand the concept of bandwidth. Simply defined, bandwidth is the amount of information that a communications link can carry over a given amount of time. Bandwidth can be compared to the capacity of a water pipe: the larger the pipe, the greater the volume of water that can flow through it. A user who is connecting to the Internet with a 56-kilobits-per-second (Kbps) modem has less bandwidth than someone connecting with a T1 connection. The slower the connection, the longer it takes data to download, as the following graph illustrates:

To put bandwidth in perspective, remember that even a T1 connection to the Internet is only as fast as a single-speed CD-ROM drive. Designing for the Web today is like designing training in the early days of multimedia. If you are accustomed to creating CD-based training, you need to become accustomed to decreasing the size of your media files for e-learning.
Multimedia applications can be media intensive, and require a lot of bandwidth. If you create learning applications that require more bandwidth than your users have, you risk forcing them to wait an unacceptably long time before they see anything appear on their computer screens. Even if you have designed the most engaging and effective e-learning course in the world, if the user loses interest before they see your application, you will not have trained anyone.

How content uses bandwidth

E-learning applications are essentially a collection of media elements that have been organized, presented, and logically sequenced onscreen to provide an effective learning experience for the user. While you can create content elements directly in authoring tools, typically they are captured or created in separate editors such as word processors, graphics packages, and video and audio editors. You then import these media assets into an authoring program such as Macromedia Authorware, Director, Dreamweaver, or Flash. The size of your application is directly related to the type and number of media assets you include in the course.

So, how do you design courses to work well over the available bandwidth? First, you must understand the relationship between media types, file size, and speed of delivery over a network. From the perspective of bandwidth, all media are not created equal. As a rule, text and simple graphics download quickly at any bandwidth level. More complex, “rich” media demands more bandwidth.

Let’s take a look at the file size required to present approximately 1 minute of each of the five major media types
Media file assumptions:
• ASCII text file containing 270 words
• Animation in Flash
• Four 320x240pixel GIF files
• 8-bit, mono, 22kHz WAV file
• 320 x 240 MPEG file at 15 frames per second

On the Web every kilobyte counts, so you must decide whether the media elements you include in your e-learning are worth the bandwidth “price” your users will pay to view them.

How browsers handle media

The types of media you use are constrained by the limitations of the browsers such as Microsoft Internet Explorer and Netscape Navigator, that support the e-learning material. Will your online training be delivered as “Web native” content, using only the browser? Browsers can display formatted HTML text and three graphic formats: GIF, JPEG, and PNG. Browsers do not natively support audio, video or sophisticated animation. To play audio, video, or animation requires a media player, also called a plug-in, installed in the users’ Web browser.

Delivering online training with either Authorware, Flash or Shockwave requires the appropriate player installed in the user’s Web browser software. The players make it possible for Web browsers to display content that is not natively supported by the browser. Fortunately, over 90% of current browsers can already view Flash and over 50% of current browsers can view Shockwave. The players for these content types are pre-installed in major browsers and operating systems. For information on where these players are pre-installed, and current statistics on the number of Web users with the Macromedia players installed, visit the following sites:
• For the Flash Player: www.macromedia.com/software/flash/survey
• For Shockwave: www.macromedia.com/shockwave/whitepaper

You can deliver e-learning content using Dynamic HTML (DHTML), which enables you to add simple animations to learning applications and create complex user interactions. DHTML requires users to have at least a 4.0 version of the browser software.
Enabling rich media and interactivity with a player

A player is a third-party add-in application installed in a browser to extend the browser’s capabilities. Using a player to deliver online training enables you to include complex animations, streaming audio, and video to your course. Online learning delivered with a player offers the developer extended authoring capabilities.

If users do not already have the player installed in their browser, they must download and install the player before they can view the course. Some users may have difficulties installing players and may require help. Many online training developers prefer player-based delivery. The ability to use rich media and the predictable appearance across different browsers and operating systems creates a consistent experience for users. Some functions, such as keyboard-based interactions for software simulations, simply cannot be performed in a browser without the addition of a player to support this richer level of interactivity.

Selecting your media

Your subject matter frequently suggests, if not dictates, your choice of media. For instance, an online course that teaches call center personnel how to handle customer complaints through simulated service calls would most effectively be delivered with the assistance of audio. An online course on human physiology might benefit from animations depicting processes that can’t be directly observed, such as how blood flows through the heart.

Prior to selecting your media, you need to ask the following questions:

• What is the user’s bandwidth?
• Are you delivering e-learning with the assistance of a player or in HTML-only format?

The answers to these questions determine what kinds of media you can use in your online course.

While it would be wonderful to select media based solely on the appropriateness for the instructional task, we do not always have that luxury. Designers are commonly forced to make trade-offs based on the limitations of their target delivery environment. The goal of this next section is to help you understand and master these trade-offs so that, for a given set of constraints, you can deliver the optimal learning experience.
Optimizing performance

The goal of your e-learning course is to provide an interesting and effective learning experience with reasonable performance. Once you have chosen your authoring software, there are two main ways that you can improve the performance of your online courses: media optimization and streaming.

Since the file size of your course is primarily the sum of the file sizes of the media elements, you’ll want to make the media files as small as possible. This is called optimization. There are tools and techniques to optimize all of the different media types. For more information, see “Optimizing content” on page 135.

When selecting what types of media to use in online training, first obtain performance characteristics for the network over which your training will be delivered, and create some guidelines for file sizes and download times. Developer guidelines differ depending on the bandwidth of your audience. Keep in mind the following rules of thumb:

• On the Web, the maximum size for each Web page should be 40K including graphics, with an ideal goal of 10K per page.
• On an intranet, the maximum size of each Web page is 100K, including graphics.

Streaming media refers to media content that is presented to the user in a continuous stream as the file is downloaded. The streamed file starts to play before it has entirely downloaded. Authorware, Director, and Flash all stream content over the Web.

Streaming is an effective way to deliver bandwidth-intensive, content without making the user wait. RealVideo is a popular streaming format for video and audio and many users already have the RealPlayer installed on their computers. Delivering RealVideo requires a special server, and involves a setup process and licensing. Other formats like those produced by Macromedia products, do not require a special server to stream media.

Optimizing content

Even though you can use streaming technologies to reduce the bandwidth required to deliver an online course, the cardinal rule of authoring for the Web is to make your courses small. This means, in large part, making the media assets that you include in your course small. You can also decrease the size of your course by reducing the size of the onscreen presentation window.

The next sections discuss five types of Web content media: text, graphics, animation, audio, and video. You’ll learn about common formats of each media type and how each uses bandwidth. Ideas for optimization and tips for effectively using the media types will also be considered.
Text

Using text in your online training has many advantages: text files are small so they perform well at low bandwidth, the user can search for specific words or phrases, and text can be easily updated. You can create text directly within an authoring application or import it from external text files.

Anti-aliasing enables you to create attractive text that blends into the background color without any jagged edges. Authorware, Director, and Flash all support anti-aliased text. Using anti-aliased text helps avoid having to create display text as a graphics file, which would make your overall course size much larger than if you simply entered text directly into the authoring tool.

Graphics

Your online training will probably consist of many graphics files so its important to understand the various formats, their strengths and how to optimize them. Your course might include photographs, illustrations of machinery, or flowcharts drawn by a graphic artist. If you create online training about a software application, you might incorporate screenshots of the application.

Graphics formats

Most Web browsers can display GIF and JPEG graphics files. Web browsers that are version 4.0 or later can also display PNG graphics files. The two most popular graphic formats for online training and Web pages in general are GIFs and JPEGs. Both are bitmap files that are relatively small in size. The two formats compress images differently, each excelling at compressing different types of graphics. Using software such as Macromedia Fireworks, you can compare the file size of your graphics with various optimization settings to help you pick the best file format.

Use the GIF format for line art and graphics that have large areas of a single color. Graphics saved in the GIF format can have one transparent color where JPEG graphics cannot. Use the JPEG format for continuous-tone images, such as photographs and images that use color gradients.

The PNG format was developed as a patent-free replacement for the GIF format. PNGs can use an alpha channel to define transparency in a graphic. Import PNG files into any of the Macromedia tools as an alternative to GIF files, especially if you need 24-bit graphics or graphics with transparency. Use this format in Web-native content only when delivering to newer browsers; some older browsers do not support the PNG format.
Optimizing graphics

Techniques for optimizing graphics include modifying file attributes, such as decreasing the number of colors resolution, and size. Optimization means compressing a file to make it smaller so it downloads more quickly. Use the correct file format, as described above, for the type of graphic you are optimizing. Tools like Fireworks can display graphics at various compression levels and file formats so you can compare the graphics and make a decision on which file has the best balance of quality and optimized file size.

If you are concerned about making your graphics look the same on all browsers and on all platforms, familiarize yourself with the Web-safe color palette. The 216 colors in this palette are found within both the Macintosh and Windows operating systems. The color palette is only an issue if any of your users will view your online training at 8-bit (256 color) color depth. At higher color-depth settings, you will not have to worry about palette issues.

You should never change the size of imported graphics directly in an authoring tool. If the graphics are too big, resize them in an image-editing application such as Macromedia Fireworks. Graphics displayed on a computer screen should have a bitmap resolution of 72 pixels per inch. Using graphics saved at a higher resolution will also make the file unnecessarily large.

Animation

Animation illustrates concepts with movement, shows processes, or draws attention to a region or elements of a screen. Since animations usually involve graphics, they are highly dependent upon the size and file type of the graphics that are being animated.

Animation formats

There are many ways you can create animations. Authorware, Dreamweaver, Director and Flash can all create animations. An animation created within an authoring program is usually smaller and more efficient than an animation created in another tool and then imported in your authoring program. This is particularly true when an animation is based on shapes created with the software's drawing tools rather than with imported bitmaps. For example, Flash excels at creating vector graphics and animations. Although Flash can animate bitmap graphics, animations made predominately with vector graphics in Flash are considerably smaller than animations created with bitmap graphics.
Optimizing animations

Optimizing animations depends on the same concepts discussed above for graphics. Since animations are graphics that are moving, an optimized animation would contain graphics that have been optimized. Different animation file formats are smaller than others. As noted above, internal animations created within tools are usually very small. The Flash format, created with vector graphics, is one of the smallest animation formats available. Animations created in Authorware and Director, if they do not contain large bitmaps, can be compact too.

Audio

Audio can enhance learning concepts and reinforce ideas presented as text or graphics on the screen. Using audio may be essential to the teaching of topics such as a foreign language or music appreciation.

There are three types of audio assets that are commonly used in e-learning:

- Music
- Narration (voice-overs)
- Sound effects

Music demands a higher-quality and a wider sound-frequency range than narration and therefore produces larger files. Narration generally has a smaller sound frequency range so it can be compressed more than music and still retain good sound quality. Sound effects are generally short so they don’t have a large impact on the overall file size of an online course.

Audio formats

The WAV and AIFF audio formats, popular on Microsoft Windows and Macintosh systems respectively, usually create files that are too large to use in an online course. Use one of the compressed formats with the goal of balancing small file size with acceptable quality audio. You have different options depending upon which authoring software you use. Both Shockwave Audio (SWA) used by Authorware and Director, and MP3, which is used by Flash are popular compressed formats useful for all three types of audio used in e-learning.
Optimizing audio

Audio files can be quite large but there are ways to optimize them for efficient playback in an online course. Optimize audio by balancing quality and file size.

Authorware, Director and Flash all have internal audio compression utilities so you may not need an audio editor to compress your audio. Authorware and Director compress audio into the streaming Shockwave audio (SWA) format. Authorware also includes a utility that compresses voice narration into the extremely compact VOX format. Flash can compress audio into the streaming MP3 standard format.

Note that when the size of an audio file decreases the sound quality usually decreases too. Audio editors use various techniques to optimize and compress audio files. To decrease the size of audio files, audio editors can change attributes of the file, such as lowering the bit depth from 16-bit to 8-bit, or lowering the sample frequency from 44kHz to 22kHz. There are also compression tools, such as Microsoft ACM (Audio Compression Manager), that supply a standard way of compressing audio but require that certain files are installed on the user's machine.

Use one of the streaming formats, such as Shockwave Audio or MP3, to deliver files that can begin to play before an entire audio file has downloaded. This enables the user to begin listening to the audio while the rest of the audio is downloading in the background. Some tools also have scripting functions to help you set how much of the sound downloads before the audio begins to play.

You can create and use Shockwave Audio in Authorware and Director. You can convert WAV files to Shockwave Audio (SWA) files by setting the bit rate. Here are suggested bit rates and the subsequent quality for Shockwave Audio:

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Bit Rate</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>64 to 128 Kbps</td>
<td>Equal to source material</td>
</tr>
<tr>
<td>ISDN, cable modem, DSL</td>
<td>32 to 56 Kbps</td>
<td>FM stereo to CD</td>
</tr>
<tr>
<td>56.6 Kbps modemFM</td>
<td>16 Kbps</td>
<td>Monaural or good-quality AM</td>
</tr>
</tbody>
</table>

Authorware includes a special application to create VOX audio files. These files are extremely compact audio files suitable for playing narration in an e-learning course. The Voxware encoder is a utility that compresses WAV files which consist of one person speaking with no background noise or music.

Director and Flash excel at multichannel sound and synchronizing audio with other events. If your e-learning course requires multiple audio files playing at the same time you might want to use one of these tools. Both tools also have audio effects such as fade in, fade out, and pan that you can apply to audio files.
Adding narration to your online training requires you to create digital audio files from a script read by a narrator. To obtain the best quality and most efficient optimization start with clean, professional quality source material. Excessive noise, hiss, and poor audio quality not only sound bad but also cause audio files to compress poorly. Using a professional narrator in a professional recording studio will give you the best results. You can then compress the digital files that result from the session.

One way to optimize musical audio is to use a short file that loops instead of one long audio track. You can loop several files to play throughout your piece. Authorware, Director, and Flash can all loop audio files.

Mono audio files are significantly smaller than stereo audio files. Save your files as mono unless you have a specific reason to use stereo audio.

**Video**

Although video requires lots of bandwidth to download, it is very useful for conveying certain information. Using video in e-learning helps realistically demonstrate equipment and processes among other things. For instance, an e-learning course in botany might show a video of a sprouting seed. A course about the features of an airplane might show a video of a crewmember properly closing and securing a door for takeoff. The intricate level of detail visible in video is also ideal for illustrating subtle, nonverbal information. For example, to teach sales skills you could use a video to demonstrate an interaction between a salesperson and a customer, then have the learners analyze the body language of the people involved in the transaction.

**Video formats**

There are three standard digital video formats: QuickTime, Video for Windows, and MPEG.

Video files tend to be large so they really aren’t appropriate for delivery on modem connections. You may choose to include video in your e-learning course if you are delivering it over an intranet or to users with relatively high bandwidth connections.
Optimizing video

Video files are never imported into an authoring tool. They remain external to the e-learning file—therefore, authoring software has no internal video compression capability and you need to compress your video file as much as possible yourself.

Like audio, you will get better compression from clean, professional source material. You can decrease your video file size by making the video presentation window as small as possible.

Video is captured, edited, and optimized in video editors such as Adobe Premiere. Just as with audio, video file size can be decreased by varying file parameters such as the CODEC used, the frame rate, and the number of colors in the palette.

You can also use a streaming video format like RealVideo. This format requires a special server that facilitates streaming. You can even turn on bandwidth detection, enabling your user to automatically receive video at the highest quality their bandwidth supports. Streaming formats integrate with the tools that you use to author online training in various ways, usually requiring a player or ActiveX control.

What if video is just too bandwidth intensive? You may be able to substitute graphic stills and audio for that video. For instance, instead of a video of a person speaking you might use a still picture of the person along with audio. This technique will considerably decrease the size of your online training. Since Flash files are considerably smaller than video files, substituting a Flash animation can also make downloading your online course much more efficient.

Authoring guidelines

Even if you are delivering your e-learning over an intranet, you need to make your course as small as possible. This section contains additional tips on how to keep your e-learning course small.

Interface Design

A clean, simple interface design can make your online training course much more compact. Create large blocks of color by using your authoring program’s drawing tools instead of importing bitmap images. Keep in mind that graphics without gradients compress much better than heavily shaded graphics. Above all, use only graphics that are necessary. Optimization, compression, and streaming cannot make up for a “heavy” design.

Training delivered on CD/DVD-ROM is now usually created for an 800 x 600 pixel screen resolution. The bigger window size is great for displaying lots of text, graphics, and rich media. For online training, however, selecting a smaller screen resolution will force you to make your courses smaller, enabling them to download quickly.
Reusing content components

Authorware, Director, and Flash all have features that allow you to store and reuse media assets instead of re-importing them into your online course. If you can reference the same graphics repeatedly instead of re-importing them, you will make your course files smaller.

- Authorware uses libraries full of media assets that can be reused throughout an application.
- Director can insert cast members multiple places.
- Flash creates symbols, which are reusable images, animations, or buttons. You can insert instances of the symbol throughout your Flash movie.
- Dreamweaver, because of the way the HTML specifications reference external graphic files, automatically reuses media.

Authorware and Director both have built-in compression capabilities for bitmap (BMP) image files. Using this file format might be as efficient as using optimized GIF or JPEG files. Do a test before you begin creating your online training: import sample BMP graphics into one file and then import optimized graphics, GIFs or JPEGs, into another file. Save each of the files and compare the sizes. Will you save time by simply using uncompressed BMP files and using the tool’s internal compression?

Status indicators

While users are waiting for online training files to download to their machine, it’s important to let them know that something is happening. You can accomplish this by adding status indicators to your online course interface. There are two effective ways to keep the user’s interest while files are downloading:

- Progress bars show how quickly a file is downloading and can be shown at any time on the screen when the user may be delayed from immediately interacting with or viewing content.
- Loader movies present a short introduction or entertaining animation that holds the user’s attention while files are downloading. A loader movie can be presented in a very small window.

Alternately, the loader movie can be a very lightweight main menu that loads other portions of the online training.

Authorware, Flash and Director all have functions that preload media onto the user’s computer. Dreamweaver has a preload images behavior that enables you to download images to the user’s browser cache so that when the image is needed the file will already be resident in the cache and will not have to be downloaded.
Authorware-specific tips

- Advanced Streamer for Authorware is included with Authorware and is a server component that predictively downloads, based on previous user data, the next segment that the user will probably request.

- Authorware Web Packager lets you experiment with segment sizes to make Authorware files play most efficiently over your target bandwidth.
  
  Remember that Authorware cannot make segments any smaller than the largest media element they contain.

- Vox audio compression is a format that is best used for narration.
  
  Use the Vox format to create extremely small files that will download quickly.

- Use a small presentation window to deliver online media and create smaller files that download quickly.

- Use 1-bit (black and white) bitmap images and then use the Authorware drawing tools to add color to them.

- Use internal media to benefit from Authorware’s internal compression. External media linked to the online training files does not benefit from the software’s compression capabilities.

- Use Authorware’s drawing tools to create simple shapes.

Director-specific tips

- Use the Publish Settings to make your graphics and sound files smaller.

- Use 1-bit (black and white) bitmap images and then use the Director’s drawing tools to color them.

- Use internal media to benefit from Director’s internal compression.

- Explore the Internet behaviors provided in Director’s Library palette.
  
  These can provide navigation control in your movie based on the download status of required media.

Dreamweaver-specific tips

- Use the Preload Images behavior to load the images into the browser’s cache while the user is reading or interacting with a Web page.

- Use hidden layers to show a previously hidden layer contained in the same Web page, rather than opening a different Web page and loading new graphics.
Flash-specific tips

• Use the bandwidth profiler to test the movie and estimate actual Internet performance.

  This shows you where the movie download may hesitate so you can make changes.

• Use tweened animations to fill in the movement between two keyframes.

  It is more efficient to let Flash calculate the frames in between specified frames than to manually place them in the movie.

• Use the Optimize command to minimize the number of separate lines used to describe shapes, apply the Optimize command to drawn objects.

• Use the MP3 audio format because it is an extremely small, streaming audio format.

• Avoid animating bitmaps—instead, use bitmap images as background or static elements.

• Use Flash’s drawing tools to create shapes.

Summary

Developing content for low-bandwidth delivery is a skill that requires understanding the relationship between media and bandwidth as well as the capabilities of the tools and technologies at your disposal. Once you’ve selected your authoring software, you can use tips and techniques to optimize your content.

This chapter has introduced you to general concepts as well as specific techniques that will help you create smaller, faster content. You now understand how to optimize all five of the common media types used in e-learning courses. Selecting and using appropriate media requires a trade-off between the requirements of your course content and the user’s bandwidth constraints. Depending upon the authoring software you choose, you can use specific optimization and streaming techniques to make course content download as efficiently as possible. If you design your online courseware well and take advantage of these techniques, you can deliver engaging, media-rich e-learning experiences even over low-bandwidth connections.
Author biography

Betsy Bruce specializes in e-learning development using Dreamweaver and Authorware. Formerly a senior developer for MediaPro, Inc. in Bothell, WA, she is now an independent consultant and a Macromedia certified instructor for Dreamweaver, CourseBuilder, and Authorware. Betsy received her B.S. degree from the University of Iowa. Betsy lives in Seattle, Washington and her Web site can be found at http://www.betsybruce.com.
CHAPTER 6
Options for Data Tracking

by Carol Fallon, president, Integrity eLearning

Using Web technology to deploy e-learning means that a large number of learners can access your courses from any place, at any time. Making all of your courses available on the Web also offers an unparalleled opportunity to track data about the learners, their progress, and results. You can implement systems to collect and store data in a central repository on a Web server and provide access to this data for learners, administrators, and managers.

The complexity of your data-tracking solution can range from simply capturing test scores in a file, to setting up an intricate enterprise-wide knowledge management system. This chapter helps you determine what data you need to track, defines the various options for data tracking, and helps you choose which tracking option best meets your needs. It also offers guidelines on selecting the most suitable Macromedia tools with which to implement your chosen option.

Why track data?

There are many reasons for tracking data about an online-learning course. If the course is mandatory or is required to meet certification or compliance requirements, you will need to monitor and track learner progress. Or, your organization may be interested in implementing some form of knowledge management.

Alternatively, if your course provides a voluntary, just-in-time, or optional education, you may not have any reason for tracking data. However, before you dismiss the idea of data tracking altogether, consider that producing your course has probably taken a significant amount of effort, time, and money. How do you know if the course was worth the investment? Data tracking can help you determine your return on investment (ROI).
Typical information you may want to find out about your course includes the answers to these questions:

- Does the course accomplish the goal it was designed for?
- Are the learners benefitting from the course?
- Is the course saving your organization money?
- How many people have completed the course?
- Are people experiencing problems using the course?
- Is the course popular?

You can find the answers to these and many other questions by collecting and analyzing data about the learners and their performance in the course.

**What do you need to track?**

You can collect many types of information about your online course. The type of information you want determines which data elements you actually need to collect. These data elements can be divided into two broad categories:

- **Learner performance data**
  - This is data that you collect to track the learners' progress through course material, as well as their testing and assessment results. Learner performance data gives you information about individual learners as well as about groups of learners. For example, you can find out whether an individual has passed a mandatory training course, as well as the percentage of students who have completed a given course, and how much time it took them to do so. You can also use this data to calculate the return on investment (ROI) for your course.

- **Course evaluation data**
  - This is data you use to assess the effectiveness of your course. You can use the information to find problems and weaknesses in your course so that you can improve it.
Learner performance data tracking

Learner performance data is the information you need to monitor learner progress, performance and behavior, and to manage how they interact with your course.

Assessing learners

The data you choose to collect for assessing each learner's progress depends upon the level of detail you need. If the course contains tests or quizzes you will almost certainly want to know if the learner passed or failed. You may want to know how many attempts the learner needed to pass a quiz or to answer each individual question on a test.

You can collect the following data items about each learner to assess their progress:

- Whether they pass or fail each test/quiz
- The score for each test/quiz
- The number of attempts at completing each test/quiz
- The time spent in course or lesson
- Success or failure in meeting the course objectives

Passing data to courses

Data tracking is not limited to data that is generated by the course; some data may be passed to the course at the start of each session. Typically, this data may be information about the learner, such as his or her name. Other data may be updated by the course and reported back at the end of each session. For example, if you are reporting the learner's highest score across multiple attempts at a test, the learner's last highest score will need to be passed to the course at the start of each session.

You can pass the following types of data about the learner to your course:

- The learner's name and ID
- A bookmark to designate where the learner stopped in the last session
- The last score for a particular test
- The number of attempts to complete the course, or an element of the course such as a lesson or test so far
- Time spent in the course so far
- The learner's progress against each course objective, such as “not started,” “incomplete,” or “complete”
Using data to control course navigation

Your course can also use data to control the learner’s path through the course content. For example, you may want to offer certain learners the option to skip the lesson content and go directly to the test, or you may want to limit the number of times that a learner can take a test. This information can be used to make your learning content adapt to the learner’s needs.

You can use the following data to control how the learners can progress through the course:

- The number of times a learner has accessed a particular lesson or test
- Whether a learner has the option to skip a lesson or test
- Prerequisites for starting a lesson or test
- The minimum score required to pass a test
- The maximum time allowed to complete a lesson or test

Data about course usage

Even if you are not tracking individual learners, you may want to collect data about the overall usage frequency of the course. You may also want to know if the learners are completing the course in a single session, multiple sessions, or taking the entire course more than once. You may want to track the completion of individual modules or of the entire course.

You can collect the following data about the level of usage for your online course:

- The name and other identifier of each learner
- The time spent by each learner using the course or individual modules of the course
- The number of times each learner accesses the course
- The number of learners who complete the course
- The number of learners who have started but not completed the course or individual modules of the course

Calculating return on investment (ROI)

A well-known benefit of e-learning is that it can save time and money. Tracking certain data can help you determine the return on investment (ROI) for a course.

If your course is developed as a replacement or alternative to classroom training, you may want to compare the cost of the two types of training. If this is your first course and you are planning to develop more e-learning courses, it can be helpful to collect data to help justify the budget for future projects.
To calculate the ROI of your course, you will need to collect the following types of data:

- The number of learners using the training
- The amount of time spent taking the course by each learner before they were able to pass the quiz or test
- The number of learners who complete the course (and those who don’t)
- The number of learners who meet the course objectives

Of course, your organization may have existing, non-technology-based ways of assessing and recording gains in learner performance. Regardless of how this information is collected, this data provides valuable input for measuring the effectiveness of your e-learning and calculating ROI.

**Volume of results-level data**

We have looked at some of the data that you can collect for results-level tracking. The amount of data collected for results-level tracking can vary widely depending on the actual data items you track and how many learners and courses you are tracking data about. In general, the more data you track, the more complex your course-development task will be. You should analyze your tracking needs carefully before you start developing your course to ensure that you collect all of the data you require to do your critical analyses and to avoid collecting redundant data.

**Detail-level data tracking**

Detail-level data is the information you need to assess the effectiveness of your course. To assess course effectiveness, you need to know what types and how much data to track. Once you have the right information, you can use it to make improvements to your course.

**Measuring course effectiveness**

As explained in Chapter 3, “Instructional Design for E-learning” on page 69 an important part of the instructional design process is to evaluate the effectiveness of your course. You must assess whether the course objectives are being met.

To assess course effectiveness, you may want to know the learner’s answer to every quiz question or the results of other interactions the learner has had with the course. You may want to compare the results of the test with an equivalent written test taken in the classroom or measure whether the pass rate of the learners is as expected. If the course offers options to the learners regarding their path through the course, you may want to track the particular paths they take.
By tracking the appropriate data you can find potential problem areas in your course and take early action to correct them. For example, you may find that a particular question is being answered incorrectly by a large number of learners. This could mean that there is a problem with the wording of the question or that the concept that the question relates to is poorly explained in the lesson material. Once you have established that there is a problem, you can investigate further to see what is causing it.

You can collect the following types of data to evaluate your course effectiveness:

- The answers given to every question by each learner
- The result of each interaction by each learner
- The number of attempts a learner makes to answer each question
- The score for each test
- The path taken through the course
- Learning objectives met
- Learning objectives failed

Detail-level data tracking can result in a large amount of data, especially if you have a large number of learners and courses to track. Before you begin collecting this type of data make sure that you can analyze it effectively. Also, you may want to collect this data for a limited time period, and then stop this level of data tracking when your course evaluation phase is over.

**Data-tracking methods**

Some of the most common ways to track data include file-based tracking, e-mail, database, and learning management systems (LMSs).

**File-based tracking**

If you intend to track a small amount of data and need a quick and inexpensive method of storing your data, using text files may satisfy your requirements.

**Storing data files**

You need to consider whether to store the data file for each learner on the learner's local hard disk or on the Web server. Storing files on the local disk is not a good option for e-learning courses. If the learner chooses to access the course from a different computer, they cannot read or update the data file. Another drawback is that files stored on the local hard disk are not very secure. Unless they are encrypted or password protected, the information they contain can be easily accessed and edited locally or even deleted.
Files stored on the Web server can be secured so that they cannot be viewed or downloaded over the Web. If you want to be able to update or read a learner's data file, you need to implement some kind of log-on procedure to ensure that the correct learner's file can be found at the beginning of each session. Another advantage of files stored on the Web server is that their contents can be made available as input data for other applications or database systems.

Implementing file-based tracking

Writing data to and from files requires some expertise in the scripting language of your chosen authoring tool. However, there are many code samples available in the appropriate Macromedia documentation, help files, and on the Macromedia Web site. There are various ways to format the data you store in a text file. However, data stored in a comma-separated or tab-delimited format has the advantage of being available for importing into a spreadsheet or database.

The following table highlights the pros and cons of using files to store data:

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storing data in files does not require any additional software.</td>
<td>Using files for data storage is not good for high volumes of data.</td>
</tr>
<tr>
<td>Data can be imported or entered into other applications.</td>
<td>This method provides no real administration capabilities</td>
</tr>
<tr>
<td>Using files to store data is inexpensive.</td>
<td>File-based tracking may not be as secure as other methods.</td>
</tr>
</tbody>
</table>

E-mail data tracking

If your requirement is simply to collect a few basic items of data about the learners and their performance in the course, an e-mail message containing the data that is sent to a training manager or administrator may fulfill your tracking requirements. If required, the information in the e-mail can be manually entered into an existing training-administration or HR system, or simply filed in the learner's personnel record.
When e-mail fails

If you choose to implement e-mail-based tracking, you need to consider what happens if the e-mail fails to reach its intended recipient. You can program your course to check for errors on sending the e-mail and take appropriate action. For example, this action could be to write the data into a file on the Web server and display a message alerting the learner about what happened. However, if the e-mail is sent successfully but for some reason it is not delivered to the recipient’s mailbox, you may not even be aware that the message did not arrive. Therefore, it is imperative to have a backup method of data collection and storage for important data that you can’t afford to lose.

Implementing e-mail tracking

The methods for sending e-mail vary between authoring tools. You can find more information from the appropriate Macromedia documentation, Help files, customer support Web sites, mailing list manager applications (such as LISTSERV) and discussion groups.

The following table highlights the pros and cons of using e-mail notification:

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail data tracking is simple to set up.</td>
<td>Delivery cannot be guaranteed.</td>
</tr>
<tr>
<td>It does not require special software.</td>
<td>Needs backup method for important data.</td>
</tr>
<tr>
<td>It is inexpensive.</td>
<td>E-mail is not efficient for high volumes of data.</td>
</tr>
<tr>
<td>Data can be imported or entered into other applications.</td>
<td>Provides no real administration capabilities.</td>
</tr>
</tbody>
</table>

Using a database to track data

If you want to keep large amounts of data and have extensive reporting requirements, tracking to a database offers significant advantages over using files or e-mail. Security is built into most database software and utilities are provided for data recovery.

After your data has been written to the database it can be retrieved by other e-learning courses or lessons, and by other information systems.
Implementing a database

Using a database to store data requires some specialized knowledge and programming expertise. In addition, setting up and administering a database requires knowledge of the chosen database software.

The method used by the course to send data to a Web server varies between each Macromedia authoring tool. Some tools offer more than one method; however almost all the methods involve using the tool’s native scripting language. Sometimes connecting to a database involves using some intermediary software, which is commonly referred to as middleware.

The following table summarizes the capabilities of each Macromedia product to read and write to a database.

<table>
<thead>
<tr>
<th>Macromedia Product</th>
<th>Open Database Connectivity (ODBC)</th>
<th>Middleware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorware</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Director</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Dreamweaver UltraDev</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Flash</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

Dreamweaver UltraDev provides a powerful capabilities for building Web-based applications that use ASP, JSP, or ColdFusion middleware to communicate with a database.

Using middleware

Middleware is software that passes data between the e-learning course and a database on a Web server. Examples of middleware include Microsoft Active Server Pages (ASP), ColdFusion, and Common Gateway Interface (CGI).

You will need some expertise in writing scripts to implement a data-tracking solution that uses middleware. Typically, you can pass data between the course and the scripts using JavaScript functions called by a Javascript URL, or functions native to your specific authoring product, such as the PostURL function in Authorware. Check your Macromedia documentation, help system, and the Macromedia Web site for guidance on interfacing with middleware.
Open Database Connectivity

Open Database Connectivity (ODBC) is a widely accepted standard for database access that uses Structured Query Language (SQL) as its query language. ODBC works well for locally delivered applications delivered on CD-ROM or LANs, but by itself is not sufficient for transmitting data over the Web. You can, however, use ODBC in conjunction with middleware which allows your application’s database calls to work over the Web. Two examples of middleware are Hot Sockets for Authorware from Ensodex or the Datagrip third-party Xtra for Authorware and Director (see “Resources” on page 168 for details). If you choose database software and middleware that supports ODBC, you will be able to change your database software in the future without having to modify your applications.

Check your Macromedia documentation, help system, and the Macromedia Web site for guidance on working with databases. In some cases, you may also find detailed instructions and sample code for your chosen authoring tool.

Software licenses

Remember that if you choose to use a database and middleware you may need to purchase a license for that software. Some software is licensed free-of-charge such as ASP, which is bundled with Microsoft Internet Information Server (IIS). However other products such as Cold Fusion require the purchase of a license. License pricing models for databases and middleware vary, so it’s a good idea to investigate the licensing and costs of these products before your proceed with your application design.

Database

Databases need ongoing administration and backup maintenance. You need to determine how the database will be backed up, how often, and by whom.

The following table lists the pros and cons of using a database to store data:

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Databases can hold large volumes of data (highly scaleable).</td>
<td>Specialized knowledge and programming is required.</td>
</tr>
<tr>
<td>Databases are secure.</td>
<td>License may add to cost.</td>
</tr>
<tr>
<td>Databases provide built-in recovery utilities.</td>
<td>Needs ongoing administration and maintenance.</td>
</tr>
<tr>
<td>Data can be accessed by other applications and reporting systems.</td>
<td></td>
</tr>
</tbody>
</table>


Learning management systems

A learning management system, or LMS, is a software application that manages the deployment, management, and tracking of e-learning courses. An LMS uses a database for storing information about learners and courses. In the past, these systems have also been known by the term CMI, which means computer managed instruction. The term LMS is gradually replacing the term CMI.

An LMS is a software application that performs the following functions:

- Learner registration and enrollment
- Collection and storage of data about learners performance
- Reporting of learners’ progress through their assigned courses
- Administration of learners and courses

Most LMSs have a learner interface and an administrator interface. The learner interface enables learners to perform the following tasks:

- Access online courses and other learning assignments
- Generate reports on their progress and results

The administrator interface enables the training administrator to perform the following tasks:

- Add, edit, or delete learner information
- Assign courses to learners
- Add, edit, or delete courses or lessons
- Generate reports on learners and courses

Evaluating LMSs

If you need sophisticated tracking and administration functions, and the ability to manage large numbers of learners and courses, then an off-the-shelf LMS may be your best option. The learning management systems available on the market today vary greatly in their specific features and functionality. To be sure that you select a system that meets your requirements, it’s a good idea to define your list of requirements before evaluating an LMS. Having a clear understanding of your requirements will help you navigate the dizzying array of options currently available on the market.
As well as defining your requirements for tracking data, there are a few key criteria that will help you to quickly narrow down the list of potential LMSs:

- Conformance to open standards such as the AICC or ADL/SCORM specifications
- The type of API provided for courseware integration
- Extended capabilities such as knowledge management or collaboration tools
- Availability of interfaces to other enterprise systems

Open standards for data tracking

The Aviation Industry CBT Committee (AICC) publishes a specification that defines a common interface for communication between e-learning courses and an LMS. Although the AICC standard was originally developed for the aviation industry, it is equally applicable to e-learning course implementations across all industries and is supported by most of the leading e-learning development tool and content vendors.

The AICC produces documents known as AGRs (AICC Guidelines & Recommendations.) Each AGR makes a technical recommendation in a specific area. AGR-010 is the document “Guidelines for Web-based Computer Managed Instruction.” These guidelines have become widely accepted as the de facto open standard for interoperability between e-learning courses and LMSs.

The AICC has developed formal certification testing procedures for testing products against AGR-010. LMSs, e-learning courses and authoring tools can all be certified as compliant with this specification. If an LMS claims to be “AICC-compliant” rather than “AICC-certified,” then it has not been through the certification test process.

You can find more information about the AICC and a full copy of the specification on the AICC Web site.

Other standards bodies such as the IMS Global Learning Consortium (IMS), the Department of Defense’s Advanced Distributed Learning project (ADL), and the European Alliance of Remote Instructional Authoring and Distribution Networks of Europe, (Ariadne) all contribute to a new IEEE standard for learning technology. The existing AICC specification will form the basis of the standard for LMS and course interoperability. It has already been carried forward into the ADL’s Shareable Content Object Reference Model (SCORM).
API for courseware integration

When you are choosing an LMS, find out what is required for your courses to communicate with the LMS. For example, some LMSs support the AICC application programming interface (API), which is part of the AICC specification. This API offers a standard set of functions that the course can use to communicate with the LMS. Also check to see what support, documentation, help files, sample code, and templates are included with the LMS.

Many Macromedia authoring programs offer built-in data-tracking features or extensions that support easy integration with LMSs. Authorware has robust features for data tracking. Macromedia is extending its general-purpose authoring software with learning extensions that provide data tracking to standards-compliant LMSs. This feature is called Knowledge Track.

Macromedia Authorware, Flash Learning Interactions, and the CourseBuilder extension for Dreamweaver all have Knowledge Track. Learning extensions that provide this feature for Director are planned as well. You can set Knowledge Track to automatically track learner performance data in a course. Knowledge Track is designed to transmit data to an AICC-compliant LMS.

Extended capabilities

Some LMSs have been expanded to include knowledge-management features such as macro-level competency testing and skills-gap analysis or to include collaboration tools such as chat rooms or discussion groups. Such levels of sophistication add to the complexity and cost of the LMS. Consider whether your organization is large enough to benefit from such features or if they are already offered by systems that you have in place.

Interfaces to other systems

Some LMSs offer hooks into other well-known and widely implemented enterprise software such as ERP and HR systems. Consider how you can leverage these systems to support your e-learning initiative.
The following table shows the pros and cons of using an LMS for data tracking.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can handle large volumes of data (highly scaleable).</td>
<td>More expensive than other methods.</td>
</tr>
<tr>
<td>Stored data can be readily exchanged with other applications.</td>
<td>Database requires ongoing maintenance.</td>
</tr>
<tr>
<td>Data is more secure.</td>
<td></td>
</tr>
<tr>
<td>LMSs provide built-in recovery utilities.*</td>
<td></td>
</tr>
<tr>
<td>Implementation doesn’t require special programming on the Web server.</td>
<td></td>
</tr>
<tr>
<td>Built-in and/or easy to customize reports.</td>
<td></td>
</tr>
<tr>
<td>Sophisticated administration capabilities.</td>
<td></td>
</tr>
<tr>
<td>Potential for extended capabilities such as knowledge management and collaboration.*</td>
<td></td>
</tr>
<tr>
<td>Potential to integrate with other enterprise applications such as ERP systems.</td>
<td></td>
</tr>
</tbody>
</table>

---

* Not all LMSs offer these capabilities.

Choosing an AICC-compliant LMS includes the following additional advantages:

- The e-learning courses that you develop and off-the-shelf courseware can coexist with and be controlled by a single LMS.
- You can produce e-learning course using lessons or other types of learning objects from a variety of in-house or off-the-shelf sources.
- Learner management, tracking and course evaluation is easier because the results of all e-learning courses taken in the organization can be stored in a single database.
- Migrating to a new LMS is easy—courses assembled in one AICC-compliant LMS can be exported and subsequently imported into another AICC-compliant LMS.
Choosing a data-tracking method

The best method for tracking course data depends upon your requirements as evaluated against several criteria: scalability, data volume, data security, programming expertise, expense, and standards-based tracking.

The following sections examine each of these criteria more closely and show how each data-tracking method measures up against these criteria. This will help you to decide which data-tracking method works best for you.

Scalability

Do you need a scaleable solution?

*Scalability* is the ease with which your tracking solution can grow to accommodate increasing numbers of learners and courses. To help you determine your requirement for scalability consider the following questions:

- How many learners and courses do you need to track?
- What is the potential size of your learner population?
- How many more courses will you be adding later?
- How much your organization likely to grow, either organically or by acquiring other organizations?

Obviously not all data-tracking options offer the same scalability. If you have a large number of learners and courses, you will need a scaleable data-tracking solution, such as a database or LMS. If you are starting with small numbers but are expecting an increase in the amount of data you need to track and store, then it is a good idea to include this capability from the start. If you don't plan ahead, you could have a difficult conversion task later on.

The table below rates the scalability of each data-tracking method.

<table>
<thead>
<tr>
<th>Data-Tracking Approach</th>
<th>Rating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>File-based</td>
<td>Poor</td>
<td>A large number of learners can lead to a large number of files to manage.</td>
</tr>
<tr>
<td>E-mail</td>
<td>Poor</td>
<td>Data sent by e-mail must be handled manually by the recipient(s).</td>
</tr>
<tr>
<td>Database</td>
<td>Good</td>
<td>Databases are designed to be scalable.</td>
</tr>
<tr>
<td>LMS</td>
<td>Excellent* (in most cases)</td>
<td>LMS are designed to be scalable.</td>
</tr>
</tbody>
</table>

* LMSs vary in their scalability.
**Data volume**

How much data will you need to collect and store?

To determine the amount of data you will be collecting consider the following questions:

- How much data will you collect for each learner and course? Are you performing results-level or detail-level tracking?
- What is the size of your learner population?
- How many courses will you be tracking?

If the volume of data collected will be relatively low, one of the more basic tracking and storage methods, such as file-based tracking or e-mail notification will probably meet your needs.

If you plan to track data about the learner’s path and the results of all the interactions in the course or lesson, you will have a high volume of data to collect and store. This means that you will almost certainly need to store the data in a database or implement a learning management system.

The table below rates the ability of each data tracking method to handle high volumes of data.

<table>
<thead>
<tr>
<th>Data-Tracking Approach</th>
<th>Rating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>File-based</td>
<td>Poor</td>
<td>Not suited to large volumes of data.</td>
</tr>
<tr>
<td>E-mail</td>
<td>Poor</td>
<td>Data sent by e-mail must be handled manually by the recipient.</td>
</tr>
<tr>
<td>Database</td>
<td>Very good</td>
<td>Databases are built to handle large volumes of data.</td>
</tr>
<tr>
<td>LMS</td>
<td>Very good</td>
<td>Uses the data handling capabilities of a database.</td>
</tr>
</tbody>
</table>
Data security

How secure does your data need to be?

Consider the following points when assessing the importance of keeping your data safe and secure:

- Does your e-learning course contain tests provided for certification, compliance, or regulatory purposes?
- Are the test results used to make decisions about hiring, promotions, and compensation?
- What is the consequence of losing some or all of the data?
- Who is permitted to access the results?
- Are the results available only to the learners and their managers?
- Are there concerns that the learners may be tempted to cheat by altering their test scores?

Obviously, each of the tracking and storage methods has different levels of data security. For example, a plain text file stored on the user’s local hard drive can be easily read, edited, or deleted. An e-mail message can be lost or accidentally deleted by the recipient. More secure methods such as a database system or a learning management system offer the best opportunities for securing and limiting access to the data.

The table below rates the data security of each data tracking method.

<table>
<thead>
<tr>
<th>Data-Tracking Approach</th>
<th>Rating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>File-based</td>
<td>Poor</td>
<td>Text files can be easily deleted or altered.</td>
</tr>
<tr>
<td>E-mail</td>
<td>Poor</td>
<td>E-mail can be intercepted or lost.</td>
</tr>
<tr>
<td>Database</td>
<td>Very good</td>
<td>Database systems have built-in security features.</td>
</tr>
<tr>
<td>LMS</td>
<td>Very good</td>
<td>LMSs use the data security features of the databases they store their data in.</td>
</tr>
</tbody>
</table>
Programming expertise

What level of programming expertise do you have or is available in your organization?

The level of expertise required to implement different data-tracking methods varies greatly. Regardless of the authoring tool you choose for developing your e-learning course, you will almost certainly need to use your chosen tool’s native scripting language to manipulate, store, and retrieve data. A tool’s scripting language comes with a set of program functions that enable you to write and read data to and from external interfaces.

Writing data to and from databases over the Web may require knowledge of a middleware product such as Microsoft Active Server Pages (ASP) or Cold Fusion. If you use an ODBC-compliant database, you will also need a good understanding of Structured Query Language (SQL) commands. Some Macromedia tools such as Authorware and Director have built-in ODBC functions that make it easier to work with ODBC databases.

The table below rates the programming expertise required by each data-tracking method.

<table>
<thead>
<tr>
<th>Data-Tracking Approach</th>
<th>Rating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>File-based</td>
<td>Low</td>
<td>Basic knowledge of scripting and string handling functions is required.</td>
</tr>
<tr>
<td>E-mail</td>
<td>Low</td>
<td>Most products have this capability built-in.</td>
</tr>
<tr>
<td>Database</td>
<td>High</td>
<td>Requires ability to format SQL commands.</td>
</tr>
<tr>
<td>LMS</td>
<td>Medium</td>
<td>Requires knowledge of scripting and API.</td>
</tr>
</tbody>
</table>
**Budget**

How much can you afford to spend?

The data-tracking methods we have described vary tremendously in cost. If you are working with a low budget, you will probably need to choose a relatively simple data-tracking solution such as e-mail notification or using your tool’s scripting language to read and write data stored in text files.

If you have a sufficient budget, consider implementing a database solution or purchasing an off-the-shelf learning management system (LMS). An LMS will provide you with the richest set of tracking and storage functions of all the data-tracking methods in return for the lowest amount of effort.

The table below rates the approximate development cost of each data-tracking method.

<table>
<thead>
<tr>
<th>Data-tracking Approach</th>
<th>Rating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>File-based</td>
<td>Low</td>
<td>Does not require any special software.</td>
</tr>
<tr>
<td>E-mail</td>
<td>Low</td>
<td>Does not require any special software.</td>
</tr>
<tr>
<td>Database</td>
<td>Medium</td>
<td>Requires some special software and considerable development effort.</td>
</tr>
<tr>
<td>LMS</td>
<td>High</td>
<td>LMS costs vary, but most are sophisticated platforms that entail considerable purchase, installation, and maintenance costs.</td>
</tr>
</tbody>
</table>
Standards-based tracking

Are you planning to add off-the-shelf content or courses developed elsewhere in your organization in the future?

If you are working with content from mixed sources, you need a data-tracking method that can be used by all your courses. Ideally, all the courses you develop or purchase should be written to the open AICC specification or in the future to the ADL API, which is based on the AICC data model. They can then be easily tracked by any standards-compliant LMS. This ensures that all courses can share the same data-tracking system and avoids the need to manage multiple data-tracking systems.

Unless you build your own standards-based tracking system from scratch, learning management systems are the only approach to data tracking that will comply with open, industry standards for data tracking.

Data-tracking methods versus selection criteria

Now that you’ve examined each of the selection criteria and evaluated it against the data-tracking methods, you can use the following table to assess which method most closely meets your requirements. Then use the subsequent table to help you select the most appropriate Macromedia product for working with your selected data-tracking method.

The following table summarizes how each data-tracking method is rated against the evaluation criteria:

<table>
<thead>
<tr>
<th>Method</th>
<th>Scaleable</th>
<th>Volume of Data</th>
<th>Data Security</th>
<th>Programming Expertise</th>
<th>Cost Standards-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>File-based</td>
<td>No</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>E-mail</td>
<td>No</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Database</td>
<td>Yes</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>LMS</td>
<td>Yes</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>
Data-tracking methods supported by Macromedia authoring programs

The following table shows how each Macromedia authoring program supports the different data tracking methods.

<table>
<thead>
<tr>
<th>Tool</th>
<th>File-Based</th>
<th>E-mail</th>
<th>Database</th>
<th>LMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Knowledge Track Xtra</td>
<td>Knowledge Track (AICC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Third-party Xtra</td>
<td>CMI functions (AICC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JavaScript URLs (other LMS protocols)</td>
</tr>
<tr>
<td>Director</td>
<td>Lingo</td>
<td>Third-party Xtra</td>
<td>Knowledge Track*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>scripting</td>
<td></td>
<td>Lingo</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JavaScript URLs (other LMS protocols)</td>
<td></td>
</tr>
<tr>
<td>Dreamweaver</td>
<td>Not available</td>
<td>HTML form</td>
<td>Knowledge Track**</td>
<td>Knowledge Track (AICC)**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JavaScript (other LMS protocols)</td>
</tr>
<tr>
<td>Dreamweaver UltraDev</td>
<td>Not available</td>
<td>HTML form</td>
<td>Knowledge Track**</td>
<td>Knowledge Track (AICC)**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JavaScript and server-side scripting (other LMS protocols)</td>
</tr>
<tr>
<td>Flash</td>
<td>Not available</td>
<td>Knowledge Track</td>
<td>Knowledge Track (AICC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JavaScript URLs (other LMS protocols)</td>
</tr>
</tbody>
</table>

* Requires learning extensions, which are planned for Director

** Requires CourseBuilder extension for Dreamweaver or Dreamweaver UltraDev

On the subject of data exchange, both Director and Flash can parse XML files. Flash is capable of bidirectional data exchange using XML through a continuous connection that it can maintain with another process or application.
Summary

As we have seen, data-tracking methods vary greatly in their capabilities and consequently in their complexity. By using the information in this chapter and carefully considering your requirements, you will be able to select the optimum solution to meet your data-tracking needs.

Resources

Aviation Industry CBT Committee (AICC)

The AICC is an international association of technology-based training professionals that develops guidelines for the development, delivery, and evaluation of training technologies. The AICC pioneered the most widely accepted interoperability standards for computer-based and Web-based training (http://www.aicc.org).

ADL

Advanced Distributed Learning (ADL) is an initiative sponsored by the U.S. Government to facilitate instructional content development and delivery using current and emerging technologies. Specifically, the ADL SCORM project focuses on the next-generation open architecture for e-learning, including standards for run-time communication, course structure, and content metadata (http://www.adlnet.org/).

IMS Project

The IMS (IMS Global Learning Consortium, Inc.) is a non-profit corporation that started with a focus on higher education, however, the current specifications and projects address a wide range of learning contexts, including schools, university, corporate and government training. Specifications available include: Learning Resource Meta-Data, Enterprise Information, Content Packaging, and Question & Test Interoperability. International IMS Centres exist in four countries to support local constituents (http://www.imsproject.org).

IEEE Learning Technology Standards Committee (LTSC)

For information about the activities of the IEEE LTSC, see http://grouper.ieee.org/groups/ltsc/index.html.
Middleware resources

**HotSockets by Ensodex.** For more information on HotSockets for Authorware, visit http://www.alleninteractions.com/frame_agent.asp.

**DataGrip.** To find out more about the Datagrip third-party Xtra for Authorware and Director, see www.datagrip.com/.

**V12 Database Xtra for Director.** To learn more about this database Xtra, visit www.integration.qc.ca/products/.

Author biography

Carol Fallon is the President of Integrity eLearning, an eLearning solutions provider. Carol and her team at Integrity produce custom-designed computer-based training (CBT) and Web-based training (WBT) for clients in a variety of industries as well as provide consulting services to organizations that are just beginning to use eLearning solutions. Integrity is also an authorized Macromedia training center.
Congratulations! Your learning content is complete and ready to post to your Web server. All that remains is to place your course online and notify your learners, right? Unfortunately, completing your course content is just half the battle. There are a few more components to add and steps to take before your learning content becomes a fully functional e-learning course.

The process of placing your course online and deploying it to your learners is rife with pitfalls. This chapter is designed to help you understand the steps involved. It reviews all the components required to deploy your course, hosting options, and how to set up and test your course. It offers guidelines and tips to help you avoid common mistakes. This information, along with careful preparation and attention to detail, will help you plan and execute a smooth, successful deployment of your e-learning course.

Course components

To successfully deploy an e-learning course you need more than just the completed course files. You may also need to provide ancillary files, configure your Web server, and deliver software to the learners’ computers to enable them to view the course content.

The components that make up your course are determined by decisions you make as you develop your content. These decisions include your choice of authoring software, what special features you choose to include in your course, and how you plan to track student progress and results.
Course files

Your e-learning course includes any content that can be viewed by a Web browser. Web content is typically made up of many small files, which perform well over low-bandwidth connections. Your content can include HTML files, graphics and media files, ASP (Active Server Pages) files and any files that you produce using Macromedia authoring software such as Authorware, Director, or Flash. Your first challenge in successfully deploying your e-learning course is assembling all the files your course requires. The second is making sure that all those files are placed in the correct locations on your Web server.

Any e-learning content that you develop with Macromedia software can include several different file types. The table below lists the file types created or required by each Macromedia product.

<table>
<thead>
<tr>
<th>Macromedia Product</th>
<th>File Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dreamweaver</td>
<td>Creates a set of folders containing all the files required to set up the Web pages for your Dreamweaver content, including: HTML (.htm or .html) files, JavaScript (.js) files, and any graphics, audio, or video files you may have created for your course.</td>
</tr>
<tr>
<td>Flash</td>
<td>Creates (.swf) files, Generator template (.swt) files, which are used if you are delivering content with Macromedia Generator, and an HTML carrier page in which the main Flash file is embedded.</td>
</tr>
<tr>
<td>Director</td>
<td>Director files (.dcr files), any external media such as graphics, audio or video files you may have used to create your course, third-party and custom extensions (Xtras, ActiveX controls, DLLs, etc.), and an HTML carrier page in which the Shockwave (.dcr) file is embedded.</td>
</tr>
<tr>
<td>Authorware</td>
<td>Authorware files prepared for the Web (.aam and .aas files), any external graphics, audio or movie files you may have used to create your course, third-party and custom extensions (Xtras, ActiveX controls, UCDs dynamic link libraries (DLLs), etc.), and an HTML carrier page in which the Authorware map (.aam) file is embedded.</td>
</tr>
</tbody>
</table>

Content created with Authorware, Flash, and Director must all be embedded in an HTML page in order for a browser to display it. Fortunately, if you are building your site with Dreamweaver, you can use prebuilt objects to easily insert content created with these products into your Web page. Dreamweaver automatically generates the necessary HTML.

Whichever software you are using to create your course, the best way to be sure you are including all the required files is check your product’s documentation and the support site. To view the Macromedia support site, visit www.macromedia.com/support/.
Additional components

There are other components you may need to install depending on the features of your e-learning course. These include media servers, collaboration software, and database or learning management system software.

Media servers are specialized servers used to deliver streaming-media over the Web. RealVideo and RealAudio are two popular streaming formats that require a media server. If your course links to such a media file, you will need to install the appropriate media server on your network.

Collaboration software can enhance your e-learning course by providing various ways for students to communicate with their instructors and with other students. For more information about how collaboration software can complement and enhance your e-learning course, please see Chapter 4, “Converting Traditional Courses to E-learning” on page 101.

If you plan to track student progress and results, you may need to install either a database or a learning management system (LMS). You should set up these components as soon as you develop the first content element capable of exchanging data with a data-tracking system. This enables you to test the interface between your course and the tracking system at the earliest opportunity and avoid replicating problems as you develop additional content. For details on data tracking methods, see Chapter 6, “Options for Data Tracking” on page 147.

Software required on client computers

Learners may also need software on their computers to take your e-learning course. Examples of software a learner may be required to download include:

- A specific Web browser or version of a Web browser
- Players such as Shockwave, the Flash Player, or the Authorware Web Player
- Any other players or client software that is required such as the RealPlayer from RealNetworks or a chat client

If you publish your course on the Internet, then you should specify the minimum software required to run your e-learning course. These system requirements, or a link to the requirements should be on the same Web page as the link to your course.

If you are publishing your e-learning course on your organization’s intranet, you can probably determine what software is currently installed on the learners’ computers and make a plan to distribute any missing items required to access and run the course.
Web browsers

For any e-learning course that you deploy, you should specify the compatible browsers and their minimum versions. Some organizations have security measures or regulations that prevent users from updating the browser on their computer. Don’t assume that your audience has the latest browser installed on their systems. For most e-learning courses, a version 4 or later browser is highly recommended. If you are delivering learning content in HTML, a version 4 or later browser is required to obtain a reasonable level of interactivity.

Players

Players, also called “plug-ins,” are additional software programs that can be installed into your browser to extend its functionality. Macromedia Authorware, Director, and Flash all use an associated player for delivering content over the Web:

<table>
<thead>
<tr>
<th>Product</th>
<th>Player</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash</td>
<td>Flash Player</td>
</tr>
<tr>
<td>Director</td>
<td>Shockwave</td>
</tr>
<tr>
<td>Authorware</td>
<td>Authorware Web Player</td>
</tr>
</tbody>
</table>

Typically, players can be downloaded for free from the vendor’s Web site. Some companies, like Macromedia, offer other distribution options, such as hosting a player on your internal Web site. For information on how to deploy players see the section “Deploying software to learner computers” on page 180.

E-mail client

If your e-learning course uses e-mail to send test results data note or as a collaboration tool, you will need to have an e-mail client available on the learner’s computer. If the tool that you are using to develop the content is capable of sending an SMTP (Simple Mail Transfer Protocol) message, an e-mail client is not required.
Hosting your course

When choosing where and how to host your e-learning course, you will need to decide whether to deploy your e-learning course from a new or an existing Web site.

If you plan to develop a new Web site, you need to determine who will be responsible for designing, developing, and setting up the site, as well as providing ongoing maintenance and support. You will also need to select a Web server. When choosing a Web server, you need to check the compatibility of the server software and operating system, with any learning management system (LMS), database software, and middleware that you plan to use to track your courses.

If you plan to deploy your course on an existing site, you’ll need to determine if that site is suitable for your e-learning course. Focus on questions of security, compatibility, performance, and administration:

- What kind of access and administrative privileges will you have?
- Is the software environment compatible with your system requirements?
- Will the existing server and infrastructure support the additional workload and traffic your course will generate?

Finally, just as when you develop a new site, you must determine who will add content to your site and perform ongoing support and maintenance.

Web-performance considerations

Your learners will quickly lose interest if your course is slow and unresponsive. One possible cause of poor performance is lack of bandwidth. Chapter 5, “Developing for Low Bandwidth” on page 131 discusses how to optimize a course for delivery over slow network connections. Another possible cause of poor performance is an over-loaded Web server. There are a number of points to consider when estimating the performance demands your courseware will place on a Web server.

In Web parlance, a Web server “hit” is a request a server receives from a client computer for some data. Every time a user browsing the Web visits a new HTML page or makes a request for data, a “hit” is made on the server.

The number of “hits” a Web server handles affects its performance. The size of your learner population and the number of courses you offer drive the number of hits. While the overall number of hits is important, the most critical factor affecting server performance is the number of simultaneous hits.

For example, if you have five hundred learners who all decide to take the same course at noon Eastern Standard Time on Monday, you may have a performance problem. However, if you have five thousand learners but only fifty of them are taking courses at any one time, then there may be no problem at all.
Your course’s actual performance will depend on the number of simultaneous hits your course receives as well as many other factors. Among those are the processing power of your server, the size of your course content files, the bandwidth of your learners’ connections, and the speed and quality of your server’s connection to the Internet or an intranet.

If your learner population is large and frequently accesses your online course, you may need two or more servers. If the learner population is spread across the globe, you may need Web servers located in different geographic regions, as Internet performance tends to slow down over long distances.

In the end, calculating server and network capacity is a difficult task. This is really a job for an expert. If your learner population is large or widely distributed, you may want to engage a networking specialist to help define your hardware and network infrastructure requirements.

**Internal Web hosting**

When deciding where to host your learning Web site, you must first determine whether to host the site on a server that is internal to your organization or to use an external hosting service. If you plan to host your Web site internally, verify that you have a secure site and that the security measures in place do not prevent the delivery of your online course.

If you are collecting data about learner performance, it is especially important to ensure that all databases or files are backed up regularly. Most experienced Web masters and network administrators use standard security measures such as backing up the site files regularly and using a firewall.

A *firewall* is hardware or software that allows access to the Internet from an organization’s internal network, but prevents unwanted access from outside the network. Many firewalls prevent downloading of files or data from the Internet onto a computer that resides on the organization’s internal network.

If there is a firewall between your learners and their e-learning course content you need to check that it will not prevent the learners from accessing any components of your e-learning course, such as streamed media files. You may be able to test this yourself. Alternatively, ask your IT department for assistance.

**External Web hosting**

If you have decided to develop a new Web site for your e-learning courses but you do not have either the time or expertise to tackle the task of setting up a server in-house, your best option is to use an external hosting service. External hosting services exist in a number of different forms including learning portals and commercial hosting services.
The hosting option that has most recently emerged on the scene is the learning portal. Some learning portals allow you to create a custom e-learning environment for your organization. Access can be limited to your organization's learners. In some cases you can customize the learner interface, so the appearance of your e-learning site matches the look and feel of your Web site. Some learning portals also offer a learning management system to help you manage your courseware and track student and course results.

The advantage of using learning portals is that they are already set up and ready to receive your course content. The disadvantages are that they can be expensive in the long run and you have limited control over how your site is set up and how it functions.

**Commercial Web-hosting services**

Commercial Web-hosting services have been around for a number of years now. These services sell space for a Web site either on a shared server or a server that is dedicated to your site. The management, security and backup of the Web site are administered by the hosting service.

Hosting services vary in the features that they offer. When choosing a hosting service, make sure that they provide the specific features you need for your e-learning courses. Compare the following important service capabilities:

- Software compatibility
- Ancillary services
- Service plans
- Performance
- Support

Software compatibility is important because the learning management system or database software you plan to use may only run on selected Web-server platforms. Ancillary services can include e-mail services for sending and receiving e-mail to and from your learners. If you are using an LMS or database for data tracking, you will need to find a service that can either host or supply the appropriate database software and any middleware you are using for data tracking.

Web-hosting services offer a variety of service plans with different allocations for disk storage space, the amount of data that can be transferred to and from your site, and the number of e-mail boxes provided. Some also offer the option of having a dedicated server. This option allows you to manage the server remotely, install any software you want, and maintain complete control of site content. Yet another possibility is “co-location.” This means that you place your own server at the hosting service's site to take advantage of their connection to the Internet. Whichever route you choose, be sure to obtain enough performance and storage space to accommodate peaks in usage, a growing database, and room to add new courses.
To ensure first-rate performance, you will want to look for a hosting service that is connected to the Internet through more than one carrier. If one carrier’s service fails, then the backup carrier is available to maintain your connection to the Internet. If you intend to expand your site, choose a carrier that can support your growth.

Finally, consider the quality of the technical support the hosting service provides. Evaluate their ability to back up your site and recover it in the event of a crash, or keep it running in the event of a power outage.

**Deploying your course**

Preparing your course for deployment involves assembling all the required components and copying them to your Web server. You need to take care to install all the required files—missing or incorrectly located files are the most common cause of problems with e-learning courses.

**Installing files on your Web server**

The following sections provide information about how to upload your course to a Web server as well as an overview of configuration and installation issues.

**HTML files**

If you are producing HTML-based learning content, then you will need to copy your learning site to the server. Most Web-authoring tools have built-in site-management capabilities. For example, Macromedia Dreamweaver allows you to create a development version of a site on a local hard drive. Once this link has been set up, you use Dreamweaver to transfer files and synchronize your local and remote sites. For collaborative working environments, Dreamweaver has check-in/check-out functions that prevent two people from editing the same file at the same time.

**Application files**

Dreamweaver also has functions for inserting Flash and Shockwave content into pages on your Web site. An extension for inserting Authorware content is available on the Macromedia Web site in the Macromedia Exchange for Dreamweaver. When you insert this content into your page, Dreamweaver generates the HTML required to launch it. Dreamweaver also allows you to set parameters for controlling how and where the content is displayed.
If you are not using Dreamweaver, there are various methods for installing your course files on a Web server. Flash and Director have built-in publishing features that help you assemble the files you need to place on the server. To transfer the files onto your Web server, you can use FTP (File Transfer Protocol) utilities. FTP utilities are generally inexpensive or available as shareware. Web browsers also include basic FTP capabilities. A list of FTP utilities is included in the Resources section at the end of this chapter. If you have access to your Web server over a LAN connection, you or your network administrator can copy files directly onto your Web server.

If your course includes content besides standard HTML and media files, you will need to copy certain ancillary files for your course to function properly. For Director and Authorware, your content will include course files, Xtras, DLLs and UCDs, external media files, and ActiveX controls. Check your Macromedia product-specific documentation and the company’s support sites for details.

**Configuration issues**

Multimedia Internet Mail Extensions (MIME) is a set of globally recognized data types that tell Web servers and browsers how to transmit and decode a particular type of file. You need to configure your Web server to recognize the MIME types for the content files that make up your e-learning course. Usually your network administrator can do this for you. Each Macromedia authoring program has a special set of MIME types for the content files it generates. The MIME type settings are specified in the documentation for each product.

**Installing specialized services**

If your course includes functionality that depends upon specialized servers, then you will need to make sure that these components are properly installed and configured as well.

A learning management system (LMS) requires you to install one or more server-side applications. An experienced Web server administrator can set up some LMSs relatively easily, but others require installation by the vendor or reseller. Since most LMSs store student and course information in a database, if you use an LMS you will need to install and configure a database server as well. The database is typically installed on a server separate from the LMS—this allows you to optimize the database server for its particular task.
If you are not using an LMS for data tracking but are using a database with server-side scripts such as Active Server Pages (ASP), Cold Fusion, or Common Gateway Interface (CGI), then you must also install and configure the appropriate server components for this software. Likewise, if your e-learning course includes collaboration features, you will probably need to install this software on your Web server. This is not required if you are linking to a third-party collaboration site from within your content.

**Deploying software to learner computers**

Installing software on your servers may not be all that is required—you also need to make sure that your learners have the hardware and software required to access your courses. Advise learners of the minimum hardware requirements to run your e-learning course. Check the documentation of all your authoring tools and any media servers you are using to determine the appropriate system requirements. Use the highest requirements specified for any one component.

Make it easy for your learners to download any required updates to their browser software. You may want to insert a link to download the required browser right on your e-learning home page. This will help ensure that the learners have the software they need to view your course. Check with your chosen browser's manufacturer for other deployment options.

If you have developed learning content with an authoring tool, your learners may need to have the appropriate player installed in their browser. Macromedia Flash and Shockwave players are pre-installed in most current browsers and operating systems. Dreamweaver has a plug-in behavior that automatically determines if visitors have the appropriate player installed (Flash, Shockwave, or QuickTime) and will redirect them to a page where they can download it, if appropriate.

All Macromedia players can be downloaded from the Macromedia Web site www.macromedia.com/software/downloads or distributed from your own site for free. Details on distributing players from your own site are available on the company's site as well. For information on distributing the Flash or Shockwave players, visit www.macromedia.com/support/shockwave/info/licensing/. For information on distributing the Authorware player, visit www.macromedia.com/support/shockwave/info/licensing/authorware/.

Remember that you want to make your course as easy to use as possible for your learners. They will soon lose interest if they run into technical problems. Use your learning home page to specify the required software and hardware, to provide the necessary software downloads and installation information and to tell your learners where and how to find support.
Testing your course

The most important thing to know about testing your course is that you can’t do it too early or too often. You should test individual course components as you create them. You must also test your e-learning course once you have assembled all the components. As a rule of thumb, you should allocate 20% of your total development time to testing. Remember that you will need several iterations of the test, fix, and test again cycle before your completed course is ready to go. Keep the following questions in mind as you test your course:

• Does the course launch and close correctly?
• Is there any missing content or links that are broken?
• Is the course performing quickly enough?

Tips for effective testing

The following list summarizes the most important testing “do’s and don’ts” required to produce a solid and reliable e-learning course.

• Test early and often.
  Test each course element such as interactions, animation sequences, and media files as you develop them. Test each module or lesson as soon as it is completed.
• Draw up a test plan and a checklist to ensure that all modules, screens, buttons, links, and functions are tested.
• Provide a flow chart of the course so testers can check that each link goes to the correct screen.
• Test your course thoroughly after you have copied all files to the Web server.
  Often a course that works perfectly on a development computer breaks as soon as it is copied to the target Web server.
• Test on as many different learner computer hardware and software combinations as possible.
• Test your course using all the supported browsers.
  For example, if you have specified Netscape Navigator and Internet Explorer versions 4 and later, don’t forget to test on version 5. Sometimes changes between browser versions can introduce problems for your course.
• Test on a computer with the minimum system requirements and lowest acceptable connection speed that you have specified for your learners.
• Don’t test the course on your development system.
  There may be elements of your course, such as fonts, Xtras or DLLs, that are
  present only on your machine that enable the course work correctly. Or, you
  may think your course is obtaining a media file from the server when in fact
  you have linked it to a path on the local hard disk.
• Test on a clean computer. Install only the software that is required to run the
  course such as the operating system, browser, players, and e-mail.
• Make use of the built-in testing features of your authoring tool, such as the
  bandwidth profiler in Flash.

**Troubleshooting**

Most problems with Web sites come down to missing files or components, and
broken links.

For example, if a special effect doesn’t work, a graphic fails to display or a movie
doesn’t play, it’s probably the result of a missing or misplaced file such as an Xtra
or DLL. Check your authoring software’s documentation for checklists of the
required files.

When you have a problem with no obvious solution, remember to check all of the
available resources:

• Troubleshooting sections of your authoring software’s documentation and
  help files
• Macromedia Web site support sections, where you can search though hundreds
  of TechNotes
• News groups and mailing-list managers (like LISTSERV) where you will find
  experienced developers who are willing to answer your questions

Use these valuable sources of help and information. Whatever the problem, there
is a good chance that somebody, somewhere, will have a solution.
Summary

As you’ve seen, there’s much more to deploying your online course than designing and developing the course content. Remember the key points that you need to cover to ensure a smooth and successful deployment:

- **Identify course components**
  Identify all the files and components that your course needs to function correctly. Define the hardware and software requirements for learner computers. Do everything you can to make running your course as easy as possible for learners.

- **Host your course**
  Evaluate the best option for hosting your Web-learning site. Decide how the Web site will be created, set up, and maintained.

- **Deploy your course**
  Plan how you are going to get all your files in place and your system correctly set up for your course’s deployment.

- **Test your course**
  Plan plenty of time in your schedule for testing. Test your course early and often. Test all course functions in the target environments.

Resources

**Technical support**

Macromedia Web site  
www.macromedia.com/support

**Macromedia player information**

Flash and Shockwave Player statistics  
http://www.macromedia.com/software/player_census/

Macromedia Player downloads and licensing  
http://www.macromedia.com/software/downloads/
FTP utilities

Dreamweaver has a built-in FTP client within the site management window. Netscape Navigator and Microsoft Internet Explorer provide basic FTP capabilities as well. Finally, there are a variety of stand-alone FTP utilities available.

- CuteFTP (www.globalscape.com)
- WS_FTP (www.ftpx.com)
- LeapFTP (www.leapware.com)

Collaboration software

For information on Ichat’s Web chat server, see www.ichat.com.

For details of O’Reilly’s WebBoard Web conferencing software, see www.oreilly.com.

Author biography

Carol Fallon is the president of Integrity eLearning, an e-learning solutions provider. Carol and her team at Integrity produce custom-designed e-learning courses for clients in a variety of industries as well as provide consulting services to organizations that are just beginning to use e-learning solutions. Integrity is also an authorized Macromedia training center.
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