Pfeiffer

Essential resources for training and HR professionals

Designing ONLINE LEARNING with FLASH

David Richard Moore

About This Book

Why is this topic important?

Education in all realms is being transformed by online learning. Online learning breaks down barriers of distance and time and has proven to be an effective method for instruction. However, online learning has largely been limited to methods that require enormous investments of instructor time. In other words, instructor-centric online learning methods do not scale well and, so far, gains in efficiency have been limited. However, tools, such as Adobe Flash™ allow you to develop online learning instruction that interacts with the learner and can reduce the burden on online instructors. The key to taking advantage of this tool is to a apply a set of instructional design strategies designed specifically for online learning with Flash, and that is what you will find in this text.

What can the reader achieve with this book?

There are plenty of generic instructional design books on the shelves, and there are plenty of generic Flash books available. What you will not find is another text like this one, one that introduces instructional design that is specifically designed to be used with Flash. By working through this text, you will learn about specific instructional design strategies for using Flash to present information to the learner and specific strategies for interacting with the learner. You will also learn the most useful Flash techniques for building this type of online learning. With the knowledge of the tools and techniques presented in this text, readers will be well on their way to creating effective online instruction.

How is this book organized?

The book begins with an instructional design model that focuses on planning, presentation and practice. The importance of each stage of this model being consistent with the others is stressed. The author next presents a series of instructional strategies that align and are consistent with the human memory system. The author then applies those strategies to the learning domains: *facts*, *concepts*, *principles*, and *procedures*. Once the strategies have been introduced, the author provides a review of the most useful Flash techniques for online learning. The book concludes with an example of an instructional application that demonstrates the selection of appropriate design strategies and Flash techniques. By this method you will advance your instructional design and Flash skills simultaneously.

Professional instructors can access an Instructor's Guide and Flash guides (posted online at www.wiley.com/college/moore), and the general public can access the Flash Guides at www.wiley.com/go/moore.

About Pfeiffer

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Designing Online Learning with Flash™

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- Why should Adobe® Flash™ and instructional design be learned in tandem?
- Why is planning central to instructional design and development?
- What are the two primary instructional functions?
- What role does learning theory have to play in instructional design?
- Why is the human memory system an important model?
- What are learning domains, and how can they improve instructional decisions?

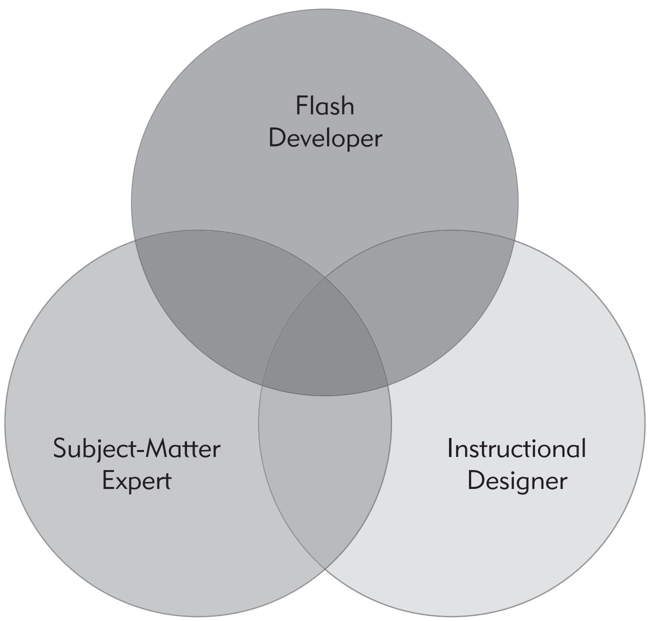
Chapter Overview

Online learning is everywhere, and it is growing. If you have not experienced learning online, you soon will. Someone has to design and construct all that instruction and, with the help of this text, that person can be you. The central

thesis of this book is simple: Online learning continues to grow and requires professionals skilled in both technology and instructional design. Meeting that challenge is difficult because you need to have technical and instructional design skills.

Instructional designers generate plans for creating effective, efficient, and appealing instruction, and technical experts, like Adobe® Flash™ programmers, implement those plans. Sometimes, instructional designers and technical experts work with an entire team, with a variety of skills, to implement an instructional project. Teams can consist of not only Flash programmers and instructional designers, but also subject-matter experts, graphic designers, writers, audio experts, and video experts. The core jobs for instructional software development are Flash developers, subject-matter experts, and instructional designers. In some cases, you may, be asked to fill all of these roles. An instructional designer plans and designs the instructional experience, the subject-matter expert provides content knowledge, and the developer implements the plans in Flash. Figure I.1 demonstrates that these roles are interdependent.

Figure I.1. The Design Team.



Unfortunately, skilled Flash programmers are rare, and knowledgeable instructional designers are rarer still. If you develop those skills, you will find yourself in demand in the job market. Few small organizations have the luxury of hiring entire teams for online learning development. As an online learning professional, you have to be prepared to perform multiple functions. At the very least, you will need to know enough about these two online learning core specialties to know the needs of both. To be an effective online learning team member or project manager, you need to have some experience with both skill sets. Unfortunately, most online learning texts do not address both areas. This book integrates them and gets you started, simultaneously, on instructional design and Flash development.

If you have experience with neither instructional design nor Flash, you will learn the basics of both in the pages that follow. If you are an experienced instructional designer, you will benefit from seeing how those ideas are applied to Flash. In this text, instructional design techniques have been presented specifically to take advantage of the affordances offered by online learning. If you are an experienced Flash developer, the presentation of instructional design ideas should broaden the type of applications you are prepared to construct.

These techniques have been organized into three broad areas: planning, presentation, and practice. All of the instruction that you develop for online learning derives from careful planning. Planning leads to the selection of strategies for presentation and practice. The strategies presented in this text align with the human memory structure, which includes sensory memory, working memory, and long-term memory. These functions directly relate to the learning domains (Facts, Concepts, Principles, and Procedures). You need to perform specific functions in each of these areas to ensure you create a quality online instructional experience. By placing the Flash techniques within the context of specific strategies supporting specific learning domains you should find the learn process straightforward.

Preface

In this book, you will be learning about both instructional design and Flash. Instructional design is “the process by which information is systematically mapped, categorized, and organized to facilitate the transmission of

information or skills to people" (Winters, 2008), while Flash "is the leading application for creating and delivering interactive content to audiences around the world, regardless of platform" (Adobe, 2008). These are both large topics, too large to be dealt with comprehensible in a single volume. Flash topics such as ActionScript, software integration, and database connectivity have been set aside. Likewise, details of the instructional design process, such as a review of the many instructional models, as been left out. What is left is a concise and practical presentation of the most important elements from both domains and demonstration of how the two support one another to produce online learning. Both Flash and instructional design are critical to the creation of online learning and as such should be introduced to you simultaneously.

Online Learning Is Growing

This book teaches you to create effective, efficient and appealing online learning using Flash as your development platform. There is a great demand for designers and developers with these skills. Online enrollments in higher education are growing at 9.7 percent, much faster that the 1.5 percent growth rate of higher education in general (Sloan, 2008). This trend should continue. Universities, colleges, and community colleges are integrating online learning into every aspect of higher education. Online learning is no longer limited to distance education; traditional classroom instructors are increasingly taking advantage of these opportunities to expand access, to provide flexible learning environments, and to meet the ever-expanding needs of lifelong learners.

John Chambers, chairman of Cisco Systems, has stated, "The next big killer application for the Internet is going to be education. Education over the Internet is going to be so big it is going to make email usage look like a rounding error" (Sallis & Jones, 2002, p. 90). Since then, the data has tended to support his position; online learning in a business context has rapidly become the preferred method of training. The demand is there, and it is growing.

Online learning has also proven itself to be an effective educational platform. Hanson and Maushak (1996) point out that, in general, distance

education has outcomes similar to face-to-face instruction and that learners rate their distance experiences similar to their experiences with face-to-face instruction. Differences in the effectiveness of any instructional experience, regardless of whether it is face-to-face or online, can be attributed to the design of instruction and rarely to the medium involved. What counts are carefully designed instructional strategies.

Designing for Productivity

Further, online learning demands heterogeneous teaching strategies. Most online learning activities use the conversation model of learning, which consist of a learner interacting with an instructor and other students through online communication tools. However, this mediated approach offers limited gains in productivity. Few instructors report saving time teaching online. The majority, in fact, report that it takes more time to teach the same number of students online than it does teaching them face-to-face in a traditional classroom.

While the conversation model has been demonstrated to be an effective method for delivering online learning, it can be augmented with instructional software. Instructional software is software that teaches; the software delivers the instructional material and provides feedback to the learner. Instructional software generally is in the form of tutorials, drill and practice, and simulations. The form chosen depends on the characteristics of the content. Instructional software allows the learner to interact with the computer, which can lead to productivity gains, as well as varying the learners' online learning experience.

Flash is a particularly useful tool for creating instructional software. It allows you to present the learner with text, audio, animation, and video. It allows you to design interactive experiences for learners and present them with appropriate feedback. Instructional software has the advantage of being available twenty-four hours a day. The learner can engage in practice at anytime and at any place. While, in most cases, instructional software cannot replicate an instructor they can provide targeted learning experiences that can augment instruction designed on the conversation model.

Fortunately, tools like Flash have advanced to the point where they are easy to learn, easy to use, and robust enough for most projects.

Armed with the basics of instructional design, you should be able to create sound instructional software modules with Flash.

Designing for Activity

The key function of instructional software is interactivity. You must have the learners do something with the software. This "something" is usually some sort of practice. In a practice-centric approach, you give learners a task, ask them to respond, and then provide them with feedback. In this way, they systematically build knowledge and develop skill. These practice sequences are central to this text and fortunately, Flash is an ideal platform to implement these progressions.

Everything Has a Purpose

In this book, it is assumed that there is an instructional rationale for everything that is involved in building a Flash application for online learning. There is no technology for technology's sake in this text. If there is not a sound instructional purpose, if it does not assist the learner, then it has been left it out. Throughout the text and, particularly, while demonstrating how to build instructional modules, notes will be included on why every screen element is present and how it assists the learner.

Instructional Design and Flash Together

Online learning, by its very nature, is an exercise in the integration of technical and design skills. It is rare to find someone who is conversant in both skill sets. In this book, essential information for both Flash developers and instructional designers is provided. Working through this book will enhance your ability to plan, develop, and generate online learning. Regardless of your role, you will be better prepared to participate in and manage team projects if you are knowledgeable about both instructional design and Flash development.

Information vs. Instruction

One of the most important lessons that designers need to learn is that information is not synonymous with instruction. Pushing information on the

learner leads to information overload. Learners too often suffer from too much information and too little analysis and synthesis of that information. What is needed is a set of strategies that encourage the learner not just to make contact with information, but to work with it to build new understandings. For learning to occur, learners need to participate, actively, in the process of integrating and assimilating new content. They need to do things. They need to engage in practice, and these practice opportunities must lead a learner from what they know to what they should know. To do that, you must strategically sequence practice strategies to encourage a logical and consistent development path.

Information specialists are trained to organize ideas logically, be persuasive, be clear, critically analyze scientific and specialized reports, and address different audiences (The American Physiology Institute, 2007), among other skills. They are interested in making information available and accessible. In contrast, *instructional* specialists are more concerned with not only making information available, but also ensuring and verifying that the user is able to perform to a standard. The nature of information presentation is that it is a one-way communication channel. Technical writers spend an enormous amount of time crafting language so that it is appropriate and digestible for the intended audience, but they rarely have an opportunity to verify that the learner received the message.

It may seem that the task of instruction is substantially more daunting than that of information. This is the case primarily because instruction requires professionally articulated information as one of its building blocks for its larger enterprise. As a result, you should not make the decision to produce instruction if information is sufficient for the task. Unfortunately, we more often run into the opposite problem: too much information and too little instruction. Inexperienced designers rarely compare the costs and benefits of information versus instruction. In fact, they are rarely are aware of the distinction between the two.

Producing instruction that goes beyond the delivery of information requires knowledge of instructional design strategies and tactics. You must know how to match up instructional goal with strategies (Merrill, 1997). You must be familiar with both presentation and practice sequences that

lead learners to build, strategically, expertise. With that knowledge, you will develop confidence that your software will really teach.

Fortunately, a tool like Flash is particularly well positioned to not only display information, but to allow the developer to implement high quality interactions with the user. The days of Flash being solely an animation program are long gone. Flash is a fully functional programming environment that we will use to develop interactions between the learner and our design.

In this book, you will learn how to create instructional presentations and practice sequences that go beyond the delivery of information. These interventions are presented through demonstrations on how to build Flash instructional modules. To get the most out of these demonstrations I suggest that you follow along and build the Flash applications step-by-step. By following this method, you will not only learn Flash, but also begin to understand the instructional rationale for the steps. It is my hope that you may use this book as the foundation for building your own interactive, instructional software.

What to Expect

This is an integrated text; however, if your interest is primarily in instructional design, you should focus your attention on Chapters 1 through 4 and Chapters 8 through 12. If your interest is primarily in Flash, you should focus your attention on Chapters 5 through 7 and Chapter 13.

The examples provided focus on Flash's graphical functions, components, and libraries. These elements are native to Flash and do not require knowledge of programming to implement. These elements demonstrate that you can create powerful instruction without advanced programming skills. Nonetheless, Flash has a powerful programming (scripting) language called ActionScript. The amount of ActionScript included in the text has intentionally been limited to the bare minimum; however, there are functions that are easier with ActionScript. At those points, be sure to copy the code provided exactly. An explanation will be provided; however, this is not a text on programming.

Chapter 7 presents a series of Flash guides. Each guide has a number of "considerations" notes. These notes are intended to bridge the gap between

the example provided and the problems one may actually encounter while developing online learning. Each guide concludes with a challenge. You should attempt to accomplish the challenges without referencing the guide. In this way, you should be building your skills by slowly removing support.

Overview of Chapters

Chapter 1: Online Learning Approach

The following questions are addressed in this chapter:

- Why is congruency important?
- Why are planning, presentation, and practice keys to successful online learning?
- Why is planning the central activity of instructional design?
- What are the limitations of content presentation?
- Why is it important for learners to be active?
- What is the role of instructional support?

Chapter 2: Planning

The following questions are addressed in this chapter:

- Why is a systematic process of planning necessary?
- What are the goals of the planning process?
- What are instructional goals and objectives?
- Why must we strive for clarity in expressing goals and objectives?
- Why must you categorize instructional goals and objectives?
- What learning domain categories are available?
- What is the driving assumption behind the instructional design process?
- What is the difference between the world of work and the world of knowledge, and how do those differences inform a task analysis?
- What is the principle of congruency?

Chapter 3: Presentation

The following questions are addressed in this chapter:

- What are the primary variables involved in designing a presentation sequence?
- What are the presentation modality, sequence, and type options?
- What are the primary instructional strategies available for presenting content?
- Why is it important to present to the learner information on learning domains?
- Should you use a direct or a discovery-based general strategy?
- How can you focus the learner's attention on the task?
- How can you maximize the learner's limited cognitive resources?
- How can you assist the learner in integrating new information with his or her long-term memory structure?

Chapter 4: Practice Sequences

The following questions are addressed in this chapter:

- What is the difference between information and instruction?
- What is the value of practice?
- What is a practice sequence?
- What role does support play in practice?
- What is the theoretical foundation for developing practice sequences?
- What type of feedback do learners require?

Chapter 5: Flash

The following questions are addressed in this chapter:

- What is Flash?
- Why is Flash ideal for a practice-centric instruction?

- What is ActionScript?
- How does Flash interact with other programs?
- How can you distribute Flash applications?
- What metaphor does Flash use?
- Why is Flash ideal for web distribution?
- How does Flash animate?
- What is the principle of reuse?

Chapter 6: Getting Started with Flash

The following questions are addressed in this chapter:

- What are the primary elements of the Flash interface?
- How can you set Flash's document properties?
- What is the Flash stage?
- How do Flash's drawing tools work?
- What is the Property Inspector?
- What is Flash's Timeline?
- How do you navigate Flash's Timeline?

Chapter 7: Flash Guides

The following questions are addressed in this chapter:

- How do you use Flash's drawing tools?
- How do you reuse elements within Flash?
- How do you manipulate text within Flash?
- How do you create animations with Flash?
- How do you allow the user to interact with Flash?
- How can you incorporate Sound within Flash?
- How do you create learning interactions and test items within Flash?

Chapter 8: Facts

The following questions are addressed in this chapter:

- How do you identify instances of the Facts learning domain?
- What strategies are appropriate for presenting content in the Facts learning domain?
- What sequences are appropriate for practicing content in the Facts learning domain?

Chapter 9: Concepts

The following questions are addressed in this chapter:

- What is a Concept and how does it relate to Facts, Principles, and Procedures?
- How do you identify instances of the Concepts learning domain?
- Why are examples important when teaching Concepts?
- Why is the range of a Concept important?
- What strategies are appropriate for presenting content in the Concepts learning domain?
- How do you create practice sequences for the Concept domain?

Chapter 10: Principles

The following questions are addressed in this chapter:

- What is a Principle and how does it relate to Facts, Concepts, and Procedures?
- What is the role of causation in teaching Principles?
- What is the difference between a Rule and a Principle?
- How do you identify instances of the Principle learning domain?
- Why are examples important when teaching Principles?
- Why is the range of a Principle important?

- What strategies are appropriate for presenting content in the Principle learning domain?
- How do you create practice sequences for the Principle domain?

Chapter 11: Procedures

The following questions are addressed in this chapter:

- What is a Procedure and how does it relate to Facts, Concepts, and Principles?
- What is the difference between a heuristic and an algorithm?
- How can you use the idea of chaining to teach Principles?
- How do you identify instances of the Principle learning domain?
- How do job aids and Procedures relate?
- Why are examples important when teaching Procedures?
- What is the role of Principles when teaching Procedures?
- What strategies are appropriate for presenting content in the Procedure learning domain?
- How do you create practice sequences for the Procedure learning domain?

Chapter 12: Case Study

The following questions are addressed in this chapter:

- How can design principles and Flash techniques be integrated and synthesized in an instructional application?
- Why is one technique chosen to fit the needs of the learning objectives?

Chapter 13: Distributing Files

In this chapter, the following questions are addressed:

- How can Flash be distributed?
- How long does it take to deliver Flash applications?

- How can Flash applications be delivered faster?
- How can Flash be delivered with and through web pages?

Chapter 14: Evaluation

In this chapter, the following questions are addressed:

- How do you know whether your instruction has been effective?
- How do you know whether your objectives have been met?
- What are the components involved in an effective evaluation?
- How can Flash send performance data?
- Why are user tests important?
- What are the differences between formative and summative evaluation?

Website and Instructor's Guide

For instructors, the finished Flash files for the Flash guides (in Chapter 7) and the Instructor's Guide are posted at the following website: www.wiley.com/college/moore. For others, access the following website for the Flash Guides only: www.wiley.com/go/moore.

Software Version

This text uses Adobe Flash CS3 Professional; however, the examples should work equally well with Flash Version 8 and Version MX 2004. The scripting examples in this text have been written in ActionScript 2.0 and should work in Flash MX 2004, Version 8, and CS3 (CS3 gives you the opportunity to create new files in ActionScript 2.0 and 3.0, be sure to select 2.0).

Summary

The important ideas in this chapter include:

- Flash and instructional design should be learned together because they are co-reliant.
- Planning should guide the instructional design process.

- The text is organized around two instructional functions: presentation and practice.
- Instructional strategies should be linked to learning theory.
- This text uses a learning theory supported by the human memory system.
- The learning domains (Facts, Concepts, Principles, and Procedures) are central to making instructional decisions.

COMING UP: ONLINE LEARNING APPROACH

In the next chapter, you will be introduced to an instructional model. This model consists of three elements, planning, presentation, and practice. You will be introduced to the importance of congruency among those three elements and among learning theory. By ensuring congruency among the design elements, you will be creating a solid foundation to build effective, efficient, and appealing instruction. You will also be introduced to instructional support's role in creating presentations and practice sequences.

1

Online Learning Approach

Guiding Questions

- Why is congruency important?
- Why are planning, presentation and practice keys to successful online learning?
- Why is planning the central activity of instructional design?
- What are the limitations of content presentation?
- Why is it important for learners to be active?
- What is the role of instructional support?

Chapter Overview

In this chapter, the specific online learning approach that has been adopted for this text is described. The approach focuses on three phases: planning, presentation, and practice. By implementing these three phases of instructional

design, you will ensure the development of quality online learning. In the planning phase, you will decide what to teach. In the presentation phase, you will decide how to share content with the learner. Finally, in the practice phase, you will give the learner an opportunity to perform. Online learning should focus on the learner actively thinking and responding. This idea is pursued throughout this chapter and the entire text.

Nothing Is Left to Chance

Many people are surprised when confronted with the number of factors that must be considered when designing instruction. A good classroom teacher/trainer will implicitly take care of many of these factors "on the fly." However, in an online learning environment you must plan to account for these details. In fact, there are so many details that require consideration that you will need to follow a systematic method to ensure you have not overlooked them. The variables that have to be considered when designing online learning are derived from science, logic, and feedback.

Science

Science will give you some ideas, but you will have to try out many strategies. Some will work, some will not. You will be presented with many principles from the science of learning; however, as you continue to develop your skills, you should try to read as much as possible from the research base. The important thing is that you should be continuing to look to science for ideas and strategies; you should continually be keeping yourself up-to-date.

Instructional designers use the science from behavioral and cognitive psychology as a foundation to guide our decisions. However, the science from these fields only offers general guidance. Every instructional situation is unique. You will have to tailor your instruction to accommodate your particular circumstances. Every instructional project has to consider different types of content, different learners, and different environments. There is rarely a single best method for doing anything in online learning.

Logic

Once you have some ideas from the science of learning, you will have to apply them. The important thing is that your instructional design not be

capricious. You should document every decision you make and have a rationale for every decision. You may be surprised at how many decisions you actually make in a design project; documenting them forces you to not to overlook any of them. You should have a reason for every objective, every presentation, and every interaction. Be prepared to defend your instructional decisions and choices.

In this text you will encounter many examples of instructional decisions. You will notice that a concerted effort has been made to provide explanations for every decision. Use these notes as an opportunity to test yourself. Ask yourself whether you agree with the rationale. If you do not agree with the rationale, try to think of another method.

Feedback

Instructional design is about making quality instructional decisions, testing out those decisions, and being prepared to modify your instruction accordingly. Ask yourself whether your designs actually help the learner learn effectively and efficiently. Instruction is worthless unless it accomplishes this goal. It takes a strong will, not only to ask whether your designs make a difference, but also to replace or revise them if they do not. The craft of instructional design requires that you marshal science, logic, and feedback to create the best instruction possible.

Instruction Is an Investment

Online learning requires an investment for the designer and for the learner. Both you and your learners could be doing other valuable things with your time. It is not acceptable to waste your time or theirs. It is also important for you to remember that there may be others with who have invested in your online learning efforts.

If you build online learning for schools or universities, you are answerable to the community. In the same way, if you work for a business or a non-profit, you can be assured that they have a stake in the training they sponsor. These communities and organizations are making an investment, and they expect you to verify that, not only have you constructed instruction, but also that your instruction prepared your learners to meet the needs of the organization.

Schools, universities, businesses, and government agencies are all institutions and exist under what is called the "institutional imperative." The institutional imperative is essentially a requirement that their activities, instructional and otherwise, further their respective missions. Therefore, they have a responsibility to document these activities and evaluate them. They must produce evidence that their institutional actions are meeting the goals of the organization.

When an organization makes an investment, it has expectations of a return on that investment. You need to gather evidence to demonstrate that training has changed and improved the participants' skills. Institutions, whether corporate or otherwise, must determine a return on investment (ROI).

You must compare the time, effort, and expense of instruction, to the net benefit generated by instruction. You can measure this for an organization by the money that they made or saved because of the training. If you work for a non-profit organization, you can measure the ROI by the degree to which performance is improved as compared to other possible interventions.

If you are going design instruction, you should make sure that it pays off as an investment. You have not completed your work until the learners can demonstrate they have learned, and that the organization or institution sponsoring the instruction can verify the results. If you cannot verify results to the sponsoring organization and to the learner, then you cannot consider your online learning a success.

My approach to online learning is, essentially, begin with science of learning, use logic to apply those principles to unique circumstances, get feedback on what works, modify your application in response, and, finally, treat online learning as an investment. If you cannot justify the investment, you should look to alternatives.

Planning, Presentation, and Practice

The principles above define the text's online learning approach. The rest of the text implements these principles through three basic instructional design phases: (1) planning, (2) presentation, and (3) practice. By attending to these phases, you can ensure that your instruction is as effective,

efficient, and appealing as possible. All three of these activities should occur systematically and congruently.

Goals Are Important (Planning)

Planning is the process of systematizing the design activities so that each instructional decision is informed by previous decisions. For example, once you identify instructional needs, the next step is to clearly articulate learning objectives. These learning objectives are unambiguous statements of what the learners will be able to do once they have concluded instruction. However, selecting appropriate phrasing for learning objectives can be difficult, and there is the temptation to describe them broadly in an attempt to ease the difficulty of the task. What often ends up happening in these cases is that the objectives no longer reflect the intent of the needs analysis. Likewise, test items should reflect the intent of the learning objectives. Some types of test items are simply easier to write, and there is the temptation to do what is easiest. Again, if this occurs, then the result is a loss of congruency.

Not only must the instructional design process be congruent, but it also must be appropriate. By appropriate I mean that, whatever the learning task is, you can categorize it and that category choice will lead to specific instructional interventions and not others. You can ensure that instruction is appropriate by appropriately categorizing it.

The Learner Must Be Supported (Presentations)

If content was comprehensible to learners without additional support, then there would be no need for instruction. As it is, most learners require varying degrees of support to understand information. The type and extent of support that you provide learners is presented through instructional strategies. When using Flash as your delivery platform, you should have specific presentation strategies in your instructional arsenal. You need to know how you are going to organize, order, and display content to the learner. It is not sufficient to state that you will “tell the learner”; you should have a plan of action. You need to decide what definitions you will use, what examples will best illustrate your points, what graphics will enhance your message. None of these decisions should be capricious.

The Learner Must Be Overtly Active (Practice)

Perhaps the most important instructional principle is that the learner should be overtly active. If you are investing in online learning, you have a stake in ensuring that your learners have learned. You cannot be sure that they have learned unless they can provide evidence of their capabilities. Further, learning is, more often than not, hierarchical: new skills build on previous skills. If a learner has acquired a skill incompletely or inadequately, or if the learner has persistent misconceptions, then he or she has endangered the development of subsequent skills.

The only way to determine whether learners have mastered a prerequisite skill is to have them engage in a performance. In essence, learning is a matter of doing things and getting feedback. The more opportunities they have to perform and get feedback the better. Practice-sequences are the most important factor in this text. Online learning is a practice-centric task.

Design Model

The instructional presentations and practice sequences both emerge from the planning process. The planning process tells us what our goals are; those goals need to be funneled into a system that leads to results. The instructional design model provides that system. The instructional design model used in this text is based on what is known regarding human information processing. The human information-processing model hypothesizes three primary memory structures: (1) sensory, (2) working memory, and (3) long-term memory (Ashcraft, 1989). Sensory memory describes one's ability to make contact with the environment through the senses. It is characterized by one's ability to select or attend to a small amount of stimuli relative to the enormous amount of information that reaches the senses. Working memory is the area in which one's conscious thinking occurs. It is characterized by its relatively small capacity. Miller's (1956) study confirming that working memory is limited to approximately seven units forms the foundation for much of the field of cognitive psychology, including the idea of cognitive load. Cognitive load refers to the working memory's capabilities. Evidence supports the idea of reducing or controlling cognitive load to improve learning (Hogg, 2006).

Table 1.1. Presentation and Practice Model

	Sensory Memory	*Working Memory*	*Long-Term Memory*
Presentation	Attention management	Cognitive load management	Structural management
Practice	Fading attention support	Fading cognitive load support	Fading structural support

Finally, long-term memory appears to be of unlimited capacity. The primary instructional challenge with regard to long-term memory is integrating new material with the learner's neuron structure (Ausubel, 2000; Zull, 2002).

These memory structures form the foundation of both the presentation strategies and the practice sequences in this text. Essentially, instruction is an attempt to artificially create conditions that assist and support the learning process and then, eventually, to prepare learners to perform under non-artificial conditions. Different presentation methods for supporting the learner associate with each of the three memory structures discussed above. Likewise, there are practice sequences that lead to performance in real-world conditions that associate with each memory structure. In general, presentation strategies create artificial conditions that support learning, while practice sequences seek to remove the use of artificial support. The two combine to create a holistic learning event. Table 1.1 illustrates the relationship between memory structures, presentations, and practice sequences.

This model will be used throughout the text to guide design and production decisions.

Summary

The important ideas in this chapter include:

- It is important to keep up with the changes in the science of learning.
- All instructional decisions must have a logically considered rationale.

- You will not know whether your instruction works if you have not tested it out.
- Online learning is an investment, and you should expect a return on your investment.
- Instructional strategies can be organized around the human memory system.
- The point of presentations is to provide the learner with support.
- The point of practice sequences is to remove learner support.

COMING UP: PLANNING

In the next chapter, the specifics of planning for instruction will be reviewed. You will be presented with a systematic model of instruction that you can follow as you work through this text and your own instructional design problems. Specifically, the analysis phase of the model, which includes (1) analyzing needs, (2) identifying tasks, (3) creating objectives, (4) classifying objectives, and (5) creating test items, will be reviewed.

2

Planning

Guiding Questions

- Why is a systematic process of planning necessary?
- What are the goals of the planning process?
- What are instructional goals and objectives?
- Why must we strive for clarity in expressing goals and objectives?
- Why must you categorize instructional goals and objectives?
- What learning domain categories are available?
- What is the driving assumption behind the instructional design process?
- What is the difference between the world of work and the world of knowledge, and how do those differences inform a task analysis?
- What is the principle of congruency?

Chapter Overview

Instruction is often perceived as an event. However, quality instruction is actually a system of events. Instructional design is essentially a cyclical process that analyzes needs, develops solutions, tries out those solutions, and revises. An instructional system includes identifying needs, developing goals, designing strategies, creating materials, and continually revising and editing these materials. The most important phase in this system is planning. Planning places your instruction on a solid foundation. In this chapter, this continual process is described in detail.

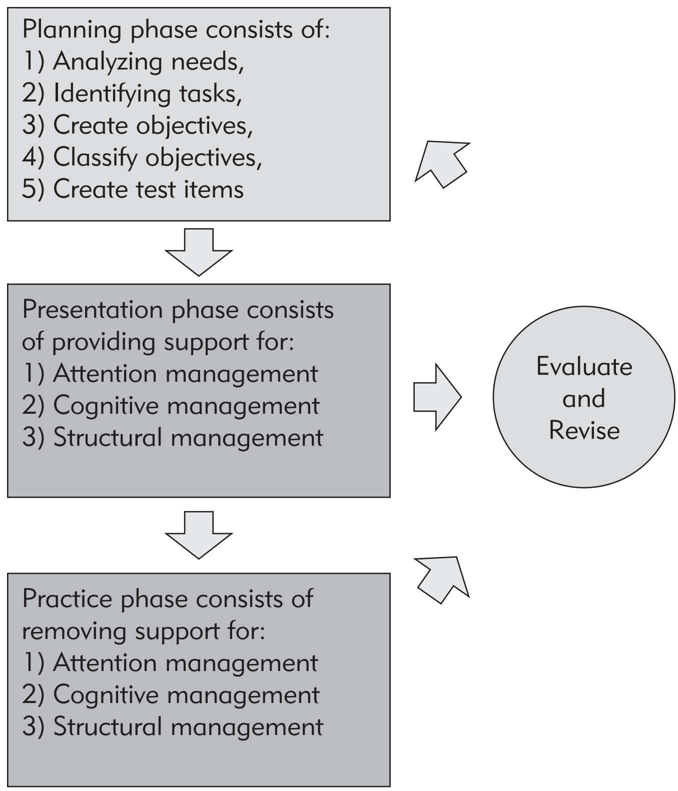
This text presents a unique instructional design model that is appropriate for instructional software. If you do not have experience in instructional design, you should review the contents of this chapter carefully. If you are an experienced designer, you will benefit from reviewing the material and integrating it into your own set of instructional design models.

Systematic Design of Instruction

In general, instructional design is like any design process; it is a method for planning and guiding the development of a product. Other design processes may create plans for cars or buildings; your goal is to design for instruction. The design model in this text includes three large phases: (1) planning, (2) presentation, and (3) and practice. Each phase offers opportunities to revise and revisit the instructional materials and assumptions. I am primarily concerned with planning in this chapter.

As demonstrated in Figure 2.1, planning consists of (1) analyzing needs, (2) identifying tasks, (3) creating objectives, (4) classifying objectives, and (5) creating test items. These stages are followed by the planning phase, which includes designing presentation and practice strategies that can be classified as attention management, cognitive load management, and structural management. Evaluation is not a separate phase because it is done concurrently throughout the entire design process. Evaluation has two components: (1) assessing the learner and (2) evaluating and revising the instructional materials.

Figure 2.1. Systematic Design of Instruction.



In the planning phase, you determine what problems need to be addressed with instruction and determine what the tasks are involved in addressing those problems. Once you have a good idea of what the problems are, you can begin to consider the learner. You will need to describe the goals to the learner. Each goal will then have to be classified. Classifying goals according to learning domains narrows down the number of instructional strategies that have to be considered in the presentation and practice phases, which should result in considerable time saving.

The development phase consists of creating presentations and practice sequences that instruct the learner. Finally, the evaluation phase consists of assessing the learner and gathering data from user tests to determine the value of the instructional product.

Each of these phases must be congruent and consistent with the other phases to ensure validity. Congruency means that each phase agrees with and supports the others. For example, a factory line has many people doing independent jobs; however, an industrial engineer has carefully planned each step to be congruent with the next. All of the steps in a congruent process contribute, seamlessly, to a coordinated conclusion. If we can maintain congruency between our instructional phases, we can be confident that our instruction, at least, will attempt to solve the problems we identified.

It might be beneficial to review what type of activity education is. Adler (1977) describes it as a cooperative activity as opposed to an operative activity. Operative activities are those that lead to outcomes that could not possibly occur with out the activity, operative activities are necessary interventions that cause outcomes. For example, heating a gas is an operative activity; heat causes gas to expand. All other things being equal, there is no chance for an ambiguous result with an operative activity.

Education, on the other hand, is a cooperative activity. Cooperative activities merely improve the probability of a particular outcome occurring. The most we can hope for, with any instructional intervention, is to make the achievement of learning goals more probable. The implication of this distinction is that selecting an appropriate instructional intervention does not guarantee results. There is no way to rank instructional strategies, techniques, and tactics on a continuum of best to worst before you have tried them out on particular problems. We do not know, beforehand, what will work for our particular goals and circumstances. This means that, if we are going to have any sort of quality control in our instructional materials, we must have a system that lets us know whether our interventions are working in the context for which they were designed.

Unfortunately, as much as we have learned about pedagogy, instructional design is largely reliant on trial and error. Instruction, while based on principles garnered from science, does not have the certainty of science. We try things, see how they work, and modify them if necessary. This is a systematic, continual, and iterative process. The advantage of this approach is that, regardless of where one starts, one will eventually end up with an appropriate and useful intervention if enough iterations can be developed. Without

thorough usability testing, it is unlikely that any instructional product will perform as intended.

Using a systematic process of instructional design assumes that the first set of strategy choices may not reflect what the final product looks like. Your initial choices for designing an intervention come from a carefully cataloged set of options derived from both science and experience. Nevertheless, these are merely suggestions; they need to be tried out on a set of sample of learners who have similar characteristics as the target audience. This sample audience is the best source of feedback. Their performance and comments are critical for revising the materials.

Analyzing Needs

A needs analysis is the first step of the planning process. At this stage, you need to determine what the need for instruction is. You need to determine whether problems exist that instruction can fix. Remember, you are only looking for needs that you can solve through instruction. Perhaps the biggest mistakes you can make as an instructional designer is to attempt to solve a non-instructional problem with an instructional intervention.

For example, a customer support representative at a call center might be consistently rude and insensitive to callers. It is important not to prematurely identify this problem as an instructional need. It may very well be a motivation problem. The representative may be aware of what constitutes quality customer service; however, he or she may have no incentive to behave in a manner that reflects that awareness. A needs analysis will help you uncover whether an instructional problem exists.

There are two primary sources for identifying needs. Van Merrienboer (1999) describes these as the “World of Work” and the “World of Knowledge.” The world of work represents needs pulled from daily tasks, particularly needs associated with occupations. These needs become apparent when there is a performance discrepancy, new tools or techniques, or when new employees are brought into an organization. For example, a master plumber asks her new assistant to troubleshoot a malfunctioning valve. If the assistant is not familiar with the various things that can go wrong with a valve, and if

he is not familiar with the tools involved in remedying the difficulty, then he will not be able to assist the master plumber. This scenario indicates a performance problem that can be addressed with an instructional intervention.

By surveying experts involved in a task, you can determine whether a need exists. There are likely to be several needs, requiring you to place them in order of importance. You do not want to spend your time on trivial tasks. Focus your resources on tackling problems that have the biggest impact. With experience, you will be able to judge how long it will take to develop instruction for different situations; at that point, it will be easier to rank order instructional needs.

It is particularly important to consider whether any need relates to a dangerous situation or to an economically important situation. For example, if you ask a new employee to operate a forklift without proper training and practice, there is a possibility that he could seriously injure himself or others. The risks of ignoring this type of training are too high to ignore. Likewise, if you ask a new employee to sort files on an adequately backed-up computer system, there is little chance for any large-scale destruction. In that case, it might be a reasonable decision to have an employee attempt to train himself for the task.

The world of knowledge is a bit different. In the world of knowledge, "a particular discipline or subject matter domain is analyzed and ordered. . . . the main output of the process is a highly structured description of the domain" (van Merrienboer, 1999, p. 5). Academic settings have organized knowledge into hierarchical structures. These structures are further organized into fields of study. It is assumed that, to participate in various types of inquiries or to participate in professions related to these domains, a learner must master a set of interrelated skills and knowledge. For example, the field of biology has a long and established history. Universities offer degrees in biology that consist of carefully organized courses. Each course covers a portion of the field. By engaging in these courses, a student develops a comprehensive understanding of the field as a whole.

Identifying needs in such an environment is largely an act of examining the established relationships and hierarchical structures in the field and determining whether the learners understand them. For an established field

such as biology, these relationships are well known and updating a course of study is a matter of determining what new information is available and how to best integrate it with currently established ideas. Identifying instructional needs is largely an act of identifying what learners have mastered and comparing it to what they do not yet know.

Identifying Tasks

Once you have identified needs that can be addressed with instruction, you will have to analyze the tasks involved in meeting those needs. The world of work and the world of knowledge have different methods for identifying tasks.

Performance Analysis

For the world of work you may want to conduct a procedural analysis. This type of analysis will break down a task into its constituent elements. From these elements, you can create objectives (discussed in the next section). The steps for conducting a procedural analysis include (Jonassen, 1999): (1) document the terminal performance of the task, (2) identify an expert to model the performance, (3) observe and interview the expert, (4) document the performance in a table, and (5) review the table with expert (s).

What you are getting at here is a comprehensive list of knowledge and skills that your learners need to know in order to be able to perform as needed. For example, let's say that you have hired a new bartender with no experience. Part of her duties include identifying inebriated patrons and then not serving them. This seems like a simple enough task; however, in practice there are a number of challenges. One customer may be inebriated and yet show few signs, while another may show the reverse.

There are also subtasks involved. For example, if your novice bartender has to "cut someone off" she must do it tactfully, in a way that does not humiliate the customer and that does not cause further problems, such as an emotional or physical outburst. With a careful performance analysis, you can identify all of the sub-skills involved. A performance analysis is demonstrated in Table 2.1.

Table 2.1. Table of Performance Analysis.

www.wikihow.com/Handle-Angry-Customers

Expert Performance	*Second Expert's Review*	*Knowledge and Skills Required*
Be patient. An irate customer will not be placated by anything but a satisfactory resolution to his or her problem.	Getting angry back will not help.	Identify signs of emotional disturbance.
Approach the angry customer and ask what why he or she is displeased.	Usually, restating the issue will help to calm them. For example, say, "I can understand your frustration with that policy."	Identify expressions of confidence and calmness.
If the customer asks for the manager, get him/her and do your best to solve the problem.	Do this as quickly as possible.	Be aware of scheduling and environmental factors.
After the problem has been addressed, apologize for taking the time and inform the customer that your business will do everything possible to correct any problem.	Then make sure you and your co-workers do everything possible to correct the situation.	Know the concept the dynamics and cultural norms of apology.
Compliment the customer after the discussion. The next time he or she comes back, do everything possible to be polite.	Say something to the effect of, "It's people like you who help our business." A customer complaint can be a vehicle for customer retention. If you handle the customer appropriately and apologize, effectively you can turn a negative into a positive.	Understand the value of long-term contacts.

What is apparent from Table 2.1 is that seemingly simple actions can require a number of sub-skills. Identifying these sub-skills can give you a great deal of direction on how to address the deficiencies of the learner.

Generally, content in the world of knowledge is well documented, so analyzing task in the world of knowledge is a bit different than it is in the world of work. Rarely will you begin with an actual performance in the world of knowledge. More likely, you will begin with some sort of text analysis. Experts play a different role in analyzing content from the world of knowledge in that they recommend updates and clarifications instead of demonstrate their skill.

For example, analyzing research in biology might result in the identification of cellular organization as an important topic, and cell size and shape, the cell membrane, the cell wall, the nucleus, cytoplasm, vacuoles and vesicles, ribosomes, endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, and plastids might be identified as subtopics (www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookCELL2.html, 2008). These topics can then be compiled into a textbook. Most textbooks in a field cover similar content. Academic content, the content that is studied in formal academic settings, emerges from the world of knowledge.

Of course, there is interplay between these two task sources. Most often, problems are originally encountered in the world of work, and then, if it is felt that they have wider importance, are integrated into the world of knowledge. For example, at some point the actions of people responsible for hiring employees began to be examined. Those who appeared to be successful had their actions evaluated in some type of performance analysis. Once a large set of these performance analyses were collected, they began to be transferred and organized into the world of knowledge, which resulted in human resources, as a field of study, being created.

Creating Objectives

At this point, it is time for you to create learning objectives, detailed descriptions of what the learner should be able to do at the conclusion of instruction. Learning objectives are not descriptions of what will be done

to the learner; but descriptions of what the learner will be able to do at the conclusion of instruction. We cannot begin to discuss instructional strategies until we have clearly articulated learning objectives that tell us what to expect out of our learners. Learning objectives give us, and the learner, a target to guide our actions. Without clearly defined objectives, there is no way to establish whether we have invested our time and effort wisely.

As we will see, instructional strategies are directly associated with learning objectives. There are an infinite number of possible instructional strategies we could try to implement; however, once we clearly state an objective, and once we classify that objective as a particular "type," then our choices of which instructional strategies becomes manageable.

Mager (1961) described three components that are required to be in each objective as follows:

1. *Behavior:* What the learner will be able to do is clearly specified. The behavior will produce unambiguous, overt evidence of mastery.
2. *Conditions:* The setting in which the behavior will take place needs to be stated. The setting includes the environment and the type and kind of assistance, if any, that the learner is provided.
3. *Standards:* The objective should include how much deviation is allowed that can still count as master.

For example, the learning objective: *Given a pair of binoculars, on a night with sky visibility at 90 percent, within thirty minutes, the astronomy student will be able to identify and list the relative coordinates of the planets Mars, Venus, and Jupiter on at least two out of three separate viewing nights.*

This learning objective is very specific. There is little ambiguity as to what the learner should be capable of at the conclusion of instruction. The learning objective can be broken down as shown in Table 2.2.

Terms such as "understand" and "know" are inadequate for describing learning objectives because they do not specify what the learner should be able to do to demonstrate mastery. Specifics are important because they guide what type of instruction the learner will receive and they guide what kind of performances the learner is expected to produce. For example, we tried

Table 2.2. Components of a Learning Objective.

Given a pair of binoculars, on night with sky visibility at ninety percent, within thirty minutes the astronomy student	Conditions
will be able to identify and list the relative coordinates of the planets Mars, Venus, and Jupiter	Behavior
on at least two out of three separate viewing nights.	Standards

to state a learning objective as: *The learner will understand how to operate the Series 7 Food Processor.*

It is ambiguous what the learners will have mastered. Perhaps they will "know" that if you turn the device on the blade will rotate. However, they may not know how to select an appropriate blade for a particular task, they may not know how to add ingredients, they may not know how to clean and care for the device. It is unclear what the term "operate" suggests.

The objective could be revised into objectives such as:

> *Given a Series 7 Food Processor, within five minutes the culinary student will be able to slice two pounds of carrots into long, thin strips, on nine out of ten attempts.*

> *Given a Series 7 Food Processor, within five minutes the culinary student will be able to clean and dry the processor's components, on nine out of ten attempts.*

The added detail makes it very clear as to what is expected of the learner.

The important point is to make objectives as useful as possible. Objectives should not be constructed for their own sake. The point is to make objectives a tool in your design process. If designed correctly, they will provide guidance for all of the other stages in the instructional development process. In general, the more specific you make an objective, the more useful it will become.

Learning objectives should follow closely from the task analysis. For example, the objectives below directly relate to the task analysis performed in Figure 2.3:

Given a set of thirty portrait photographs, within five minutes the customer representative will be able to sort the set into those demonstrating frustration and those demonstrating distraction, with an 85 percent success rate.

Given a set of five videos of a customer service representative apologizing, the customer representative will be able list the stages of apology that are absent in each scenario, with an 80 percent success rate.

Likewise, learning objectives can be developed from a text analysis. For example, the objectives below are produced based on the previously mentioned biology studies.

Given a diagram that includes the cell structures (cell membrane, nucleus, endoplasmic reticulum, chloroplasts, and mitochondria), and a list of those structures, in two minutes you will be able label each one appropriately, with no errors.

Given no assistance, you will be able to describe, through both words and illustrations, the functions of the nucleolus and the nuclear envelope, the description should accurately account for the principles involved.

Classifying Objectives

The field of instructional design is based on the assumption that different kinds of learning exist and that different instructional strategies are required for each kind of learning (Gagné, 1985). This assumption addresses one of the most difficult problems instructional designers face. For example, if you are going to teach someone to shoot a basketball, what strategy would you use? Would you:

- Provide a demonstration, perhaps many different demonstrations from different players?
- Provide a list of steps?

- Have the person memorize the steps?
- Have the person try to shoot a basketball on the court?
- Describe the history of the form?
- Have the person practice the movement ten times? One hundred times? One thousand times?
- Provide examples of poor shooting style?

Likewise, if you were teaching someone to distinguish Georgian from Victorian architecture, would you:

- Provide a definition of each?
- Ask the person to sort instances of both?
- Have the person memorize a mnemonic of each style's primary attributes?
- Have the person create designs for each?
- Use flash cards matching attributes to styles?

Your choices are endless. However, by matching up learning objectives with learning domains, we gain a clearer idea of what strategies we should use.

Once instructional objectives have been identified, they then can be classified. Categorizing individual objectives allows you to work with them as a class—a set with similar characteristics. This is an enormous time saver. It is much easier to create instructional solutions for a small set of categories than to address each learning objective as a unique instance.

There are many ways in which to classify content. Bloom's taxonomy (1956) uses the categories of Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation to categorize learning objectives. Gagné's taxonomy (1985) used the categories Attitudes, Cognitive Strategies, Intellectual skills, Psychomotor Skills, and Verbal Knowledge. However, for online learning, I have chosen to use Merrill's (1983) category system. Merrill (1983) proposed a classification that emphasized the cognitive aspect of intellectual skills. He suggested that most learning objectives could be classified as enabling Facts, Concepts, Principles, or Procedures.

This classification system is very specific and uses the terms (Facts, Concepts, Principles, and Procedures) in specific ways that may not be familiar to you. For example, the term "concept" is often used as a synonym for an idea or a notion; however, in this classification system, the term is used to designate entities that have been grouped according to a set of attributes or characteristics. The term "principle" is often used to designate a basic truth; however, in the context of instructional design it describes a relationship between two or more "concepts." For example, in Table 2.3 I have classified a set of learning objectives and have included a brief summary of each category.

These categories are used to organize the instructional strategies in this text. The specifics of how and why you would classify a learning objective into a particular classification will be covered in Chapters 8 through 11.

It is sufficient at this point to state that the chosen classification for learning objective leads to a set of instructional strategies that have been shown to be successful in teaching that subject matter. This is a critical point because learning is dependent on instructional strategies more than any other variable; much more so than the media or the technology chosen to deliver instruction (Hannifin & Hooper, 1993).

If you misclassify an objective, you will be teaching the learner with misaligned strategies and thus ruining any hope for congruency among objectives, methods, and assessments. In other words, your instruction will have no coherence and is likely to be a hindrance in accomplishing your goals.

Creating Test Items

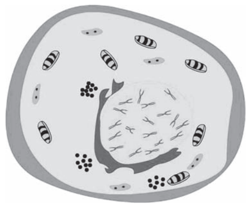
The last step of the planning phase is to write test items. It may seem counterintuitive to write these before you select instructional strategies and before you develop the instructional materials; however, because congruency among all of the elements is an important instructional design rule, it makes sense to make a clear connection between the learning objectives that we have identified and the test items. One of the biggest mistakes in instructional design is not to make this connection. For example, Table 2.4 demonstrates the relationship between learning objectives and test items.

Table 2.3. Matching Learning Objectives and Learning Domains.

	Summary	*Sample Learning Objective*
Facts	Facts are essentially arbitrary associations.	Given a diagram that includes the cell structures (cell membrane, nucleus, endoplasmic reticulum, chloroplasts, and mitochondria) and a list of those structures, in two minutes you will be able label each one appropriately, with no errors.
Concepts	A concept is a classification of entities that share the same features or attributes, such that you can consider them a group.	Given a set of thirty portrait photographs, within five minutes the customer representative will be able to sort the set into those demonstrating frustration and those demonstrating distraction, with an 85 percent success rate.
Principles	A principle describes how two or more concepts are related and provides an explanation for that relationship.	Given no assistance, you will be able to describe, through both words and illustrations, the functions of the nucleolus and the nuclear envelope. The description should accurately account for the principles involved.
Procedures	Procedures are series of steps performed in order under specific conditions. Underlying each procedure is a set of rationales and principles.	Given a set of five videos of a customer service representative apologizing, the customer representative will be able list the stages of apology that are absent in each scenario, with an 80 percent success rate.

Notice how the objective reflects the learning objective. Also, notice how the objective limits the scope of the test item. For example, learning objective 1 in the table clearly states that a diagram will be provided, but this description does not allow for a photograph of a microscope or another type of representation.

Table 2.4. Connecting Learning Objectives and Test Items.
Image from www.biotechnologyonline.gov.au/popups/img_cellwithlabels.cfm

	Learning Objective	*Test Item*
1.	Given a diagram that includes the cell structures (cell membrane, nucleus, endoplasmic reticulum, chloroplasts, and mitochondria) and a list of those structures, in two minutes you will be able label each one appropriately, with no errors.	 Match the following structures with the diagram above: Cell membrane Nucleus Endoplasmic reticulum Chloroplasts Mitochondria
2.	Given a set of thirty portrait photographs, within five minutes the customer representative will be able to sort the set into those demonstrating frustration and those demonstrating distraction, with an 85 percent success rate.	The facial features of this person indicate: Frustration  Distraction 
3.	Given no assistance, you will be able to describe through both words and illustrations, the functions of the nucleolus and the nuclear envelope. The description should accurately account for the principles involved.	Describe how the nucleolus and the nuclear envelope function. Be sure to describe the nature of their cause an effect relationship, particularly, as it relates to ribosome storage.
4.	Given a set of five videos of a customer service representa-tive apologizing, the customer representative will be able list the stages of apology that are absent in each scenario, with an 80 percent success rate.	Which stage of apology is absent from Video 4: Regret Repentance Apologizing Forgiveness

Identifying cellular structures in diagrams is an easier task than it is with an actual photograph because a diagram is a stylized representation; the guidance from the objective is unambiguous.

Extended Example

Overview

This section of the chapter presents a case study on Supply and Demand Dynamics. The case is presented by stepping you through the instructional design planning process, which includes (1) how the need for instruction is established (needs analysis), (2) how the tasks involved are identified (task analysis), (3) how learning objectives are generated, (4) how learning objectives are classified, and (5) how test items are created.

Case: Supply and Demand—Dynamics

Introduction In this section, you will walk through the entire instructional design process beginning with a description of a case, which describes all of the elements in from the Planning, Presentation and Practice chapters. Once the case is described you walk through the development of a Flash application, step-by-step, to address the needs of the case. Along the way, you will be introduced to the instructional rationale for each action.

For this case, you will observe an instructional Design planning process, which will be followed up in chapter 12 with a guide on how to select Flash techniques to develop presentations and practice sequences in Flash that align with attention management, cognitive load management and structural management strategies. At each point, when one of these strategies, is used it will be described in detail; these descriptions will be set off from the procedures describing the Flash activity.

Needs Analysis Identifying problems that can be solved with instruction is the first step of the instructional design process. You will need to discriminate instructional problems from organizational problems or management problems. Once you have identified instructional problems, you must prioritize them and focus the rest of your design and development efforts

on those instructional problems that have the most potential to improve performance.

In the case below, you are introduced to a situation in which you will assume the role as a training firm, hired to improve performance. Your training firm has been hired by a convenience store chain to train their managers on a variety of economic skills and issues. Specifically, the chain is concerned that their managers do not have the requisite skills to maximize their stores' profits. After surveying a large sample of store managers, it has become apparent that few of the managers set prices strategically. Your firm consulted with an economist (a subject-matter expert) who has reviewed the survey and has suggested that store managers are not aware of how to set prices on their various products and as a result do not maximize profits when they set prices.

The common tactic seems to be the raising or lowering of prices for all store products by the same percentage. You suspect this may be because the store managers are busy, and this is an expedient strategy. However, after a series of follow-up interviews, you become convinced that the store managers are not knowledgeable about different pricing strategies. This suggests to you that you have a training problem and not a motivation problem. Your subject-matter expert has suggested that the store managers are not aware of the dynamics of supply and demand, and that they are not familiar with the concept of "price elasticity."

Task Analysis Now that you have determined that the problem can be solved with an instructional intervention, the next step in the planning process is to identify the tasks involved in addressing the problems generated in the needs analysis. This involves interviewing experts who have solved similar problems and perhaps observing those experts while they perform those tasks.

Although you are familiar with the idea of supply and demand, you are not sure that you completely understand what is involved in using those tools to set prices for a store. You set up an appointment with your economists and she makes the following points:

- Supply and demand dynamics explain how price and quantity are related through the behavior of suppliers and consumers. Consumers

are willing to purchase a particular product at a particular price; if the price changes they will purchase more or less of that product. Likewise, producers are willing to sell a particular product at a particular price; if the price changes they will be willing to sell more or less of that product.

- Consumer and producer behavior at different prices and quantities can be represented graphically, with both supply and demand having their own curves.
- The behavior of the consumer and the producer interact and form an equilibrium when the two curves intersect that identifies a price and quantity to be both produced and consumed.
- Further, each product has its own curve, which indicates that changes in the price of some products can have a larger or smaller effect on the quantity sold. For example, an increase in the price of tickets to a sporting event may dramatically reduce the quantity demanded because the consumer may have other, less expensive options for entertainment, while an increase in the price of gasoline may not reduce consumption at all because drivers often have limited options to fulfill their transportation needs. This is called elasticity.
- These supply and demand dynamics are stable. However, supply and demand curves can be shifted if something changes the essential nature of either one. For example, the consumers' demand curve could be shifted if there is a substantial increase in their collective incomes, or producers' supply curve could be shifted if they adopt a new, more efficient manufacturing process.
- These dynamics are best understood by creating graphs and manipulating them under different scenarios.

The economist suggests that the store managers should become knowledgeable about supply and demand graphs, elasticity, how to calculate elasticity, and how to make pricing decisions based on the nature of particular products. She also suggests that the store managers become aware of some of the history of these ideas to give them context.

Based on your conversation with your subject matter expert you have mapped out the tasks in Table 2.5.

Table 2.5. Supply and Demand Tasks.

Terminal Task	*Component Tasks*	*Knowledge and Skills*
Store manager will be able appropriately adjust prices to maximize profit.	Supply and Demand Dynamics	Parts of the supply and demand graph; Difference between curves and shifts; Identifying equilibrium points.
	Elasticity	Defining elasticity; Classifying different products according to their elasticity; Predicting price changes depending on elasticity; Calculating elasticity
	History	Awareness of the four major contributors to supply and demand theory and their relative time of discourse.

Objectives, Classes, and Evaluation From the task analysis, we can create specific learning objectives, assign those objectives to learning domains, and write initial test items. These actions lay the foundation for targeting specific instructional strategies.

Learning Objective 1

Given a supply and demand graph, you will be able to identify and appropriately label the parts of a supply and demand graph including price, quantity, equilibrium point, supply curve and demand curve. You will be able to accomplish this task seventy-five percent of the time.

Learning Domain Fact

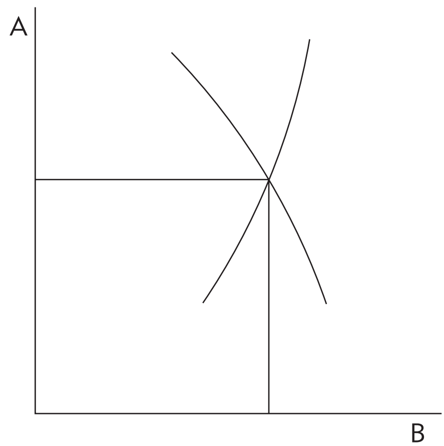
A supply and demand graph is arranged in a somewhat counterintuitive manner. In most graphs, we tend to put the dependent variable on the

vertical axis. In the case of a supply and demand graph the dependent variable, price (because price tends to predict quantities produced and consumed), has been placed on the horizontal axis. This arrangement must be associated by the e-learner and thus belongs in the fact domain.

Evaluation Which axis below is the Price axis?

A*

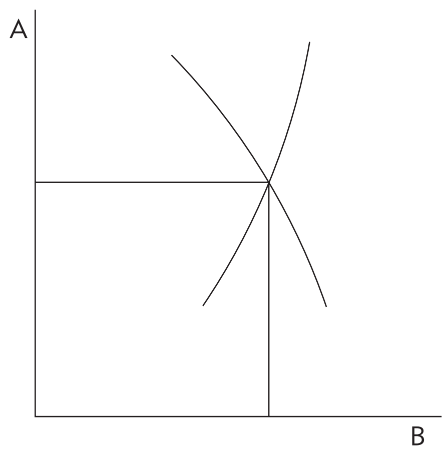
B



Which axis below is the Quantity axis?

A

B*



Learning Objective 2F

Given a list of key economic theorists, you will be able to associate their names with their relevant ideas. You will be able to perform this task with a 75 percent rate of success.

Learning Domain: Facts

Identification and association are classified as facts because the task requires that the learner select and apply appropriate labels.

Evaluation Match the following theorist with his or her major text.

Theorist	*Text*	*Correct Match*
A. Stuart	1. Principles of Political Economy	A-1
B. Smith	2. Wealth of Nations	B-2
C. Cournot	3. Principles of Economics	C-4
D. Marshall	4. Mathematical Principles of the Theory of Wealth	D-3

Match the following theorist with his or her major idea.

Theorist	*Idea*	*Correct Match*
A. Mill	1. equilibrium point where the two curves crossed	A-4
B. Smith	2. developed a mathematical model of supply and demand	B-3
C. Cournot	3. assumed that the supply price was fixed	C-2
D. Marshall	4. first used phrase "supply and demand"	D-1

Learning Objective 3C

Given a supply and demand graph, you will be able to classify the demand curve as being elastic, inelastic, perfectly elastic, or perfectly inelastic and will be able to accomplish this task 75 percent of the time.

Learning Domain: Concept

Elasticity is a concept because it allows you to classify its instances. It is helpful to know the definition of elasticity; however, ultimately you will need to classify unencountered examples to provide evidence that you have mastered the concept.

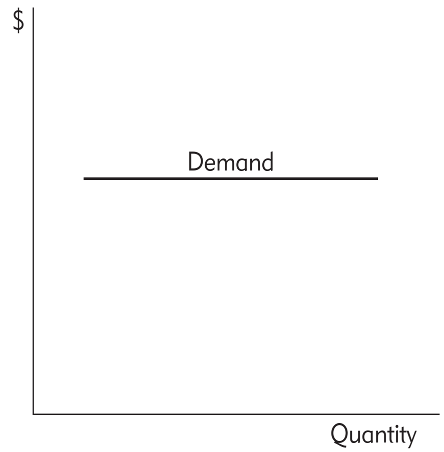
Evaluation In the graph below, the Demand curve represents:

A. Perfect Elasticity *

B. Perfect Inelasticity

C. Elasticity

D. Inelasticity



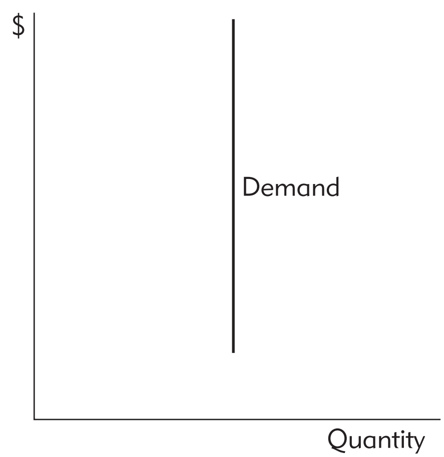
In the graph below, the Demand curve represents:

A. Perfect Elasticity

B. Perfect Inelasticity *

C. Elasticity

D. Inelasticity



Learning Objective 4 Pro

Given a scenario describing a customer's buying patterns, you will be able to calculate that customer's price elasticity of demand, and your calculation will be within 5 percent of the actual elasticity.

Learning Domain: Procedure

This objective is placed in the Procedural domain because to accomplish the task requires a series of steps. In this case, you are calculating, which requires selecting relevant data from the irrelevant and processing that data using a pre-determined methodology.

Evaluation What is the consumer's price elasticity of demand for bushels of apples in the following scenario? When apples cost $20 a bushel, consumers are willing to buy ten bushels of apples, and orchards are willing to sell ten bushels of apples. When they cost $1.50 each, consumers are willing to buy only six bushels, and orchards are only willing to sell fifteen bushels. Orchards sold two hundred bushels last year.

Learning Objective 5P

Given a scenario in which both the Supply and Demand curves shift, you will be able to state the equilibrium point in reference to the newly established Price and Quantity figures; you will be able to perform this task ninety percent of the time.

Learning Domain: Principle

Objective 1 examines the dynamic causal relationships displayed among the concepts Supply, Demand, Equilibrium, Price, and Quantity. Knowledge of these concepts is a prerequisite.

Evaluation An increasing shift in the Supply graph will shift the equilibrium point from A to _.

A

B * is correct

C

D

A decreasing shift in the Demand graph shift the equilibrium point from A to _.

A

B * is correct

C

D

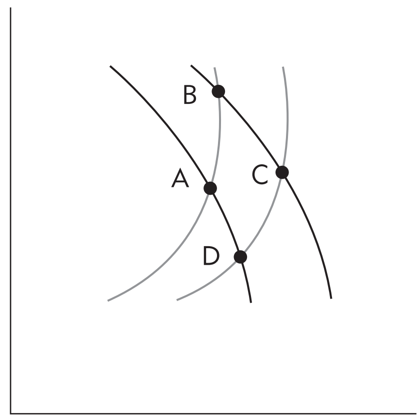


Table 2.6 summarizes the planning process.

Table 2.6. Planning Summary.

Economics Sub-Topics	*Facts*	*Concept*	*Principles*	*Procedures*
History	Objective 1			
Parts of Graph	Objective 2			
Elasticity		Objective 3		
Calculating Elasticity			Objective 4	
Finding equilibrium: Laws of supply and demand				Objective 5

Summary

The important ideas in this chapter include:

- Designers should use a systematic process of planning for instruction.
- Congruency and consistency are important for all phases of instructional design.
- It is important to continually revise instructional materials.
- Learning objectives should be matched with learning domains.
- Test items should be matched with learning objectives.

COMING UP: PRESENTATION

In the next chapter we will review strategies for presenting content to the learner. Clarity is of prime importance to any presentation of content and can be enhanced by focusing your attention on the mechanism, modality, and level of abstraction you choose for any presentation. These presentation characteristics can be used to create the primary presentation strategies: (1) attention management, (2) cognitive load management, and (3) structural management. The presentation chapter lays the foundation for specific instructional strategies discussed in Chapters 8 through 11.

3

Presentation

Guiding Questions

- What are the primary variables involved in designing a presentation sequence?
- What are the presentation modality, sequence, and type options?
- What are the primary instructional strategies available for presenting content?
- Why is it important to present to the learner information on learning domains?
- Should you use a direct or a discovery-based general strategy?
- How can you focus the learner's attention on the task?
- How can you maximize the learner's limited cognitive resources?
- How can you assist the learner in integrating new information with his or her long-term memory structure?

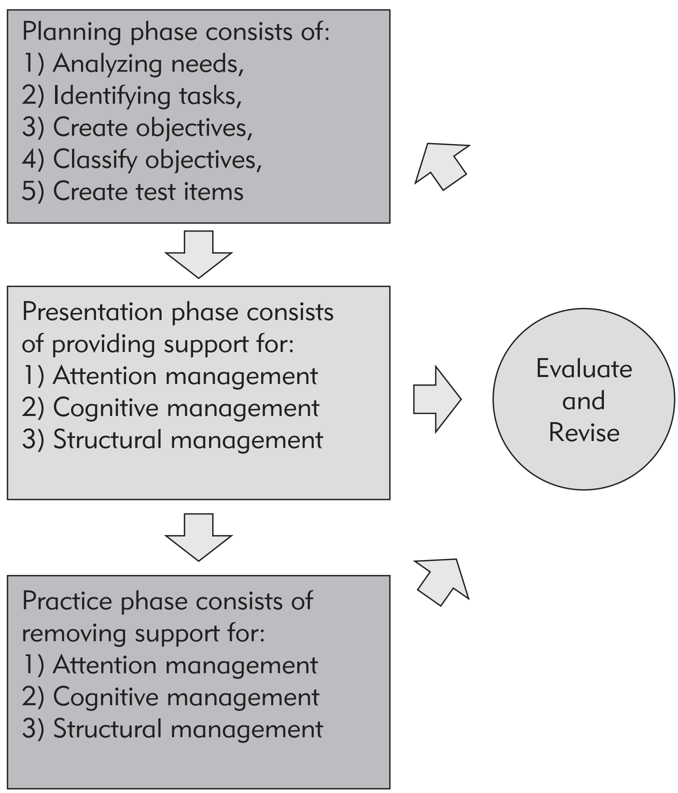
Chapter Overview

Learners primarily encounter content through presentations. A presentation should provide the learner with clear, unambiguous information. Presentations must be accurate, readable, and audience appropriate. Each learning domain requires that a different type of presentation is provided to the learner.

Presentation Phase

The presentation phase is part of the instructional design model for online learning. Figure 3.1 indicates how this phase relates to the planning and practice phases.

Figure 3.1. ID Model.



Designing a presentation is largely a process of making decisions that manipulate information so that it is appropriate for our sensory, working, and long-term memory structures. Presentations add specific and targeted support to make information more comprehensible. To manipulate information so that it conforms with the capabilities of these memory systems requires that you communicate with the learner through a medium. Becoming knowledgeable of the characteristics of different mediums can help you make appropriate instructional strategy choices.

Presentation Medium

Any presentation requires a series of decisions that determine just how the learner encounters the material. The medium is the means by which information is stored, distributed, and communicated. The medium has a number of separate components including (1) the mechanism, (2) the modality, and (3) the level of abstraction. Each time you present information to the learner, you will have to make decisions regarding each of these components.

In this text, you are learning Flash and so many of decisions related to these components will already have been made. By default, Flash is the platform for instructional delivery. Nonetheless, there are still a number of decisions that you will have to make, particularly in regard to modality and degree of realism.

Presentation Mechanism

The presentation mechanism is the physical technology of the medium. For example, television, radio, and the Internet are all forms of mechanisms for delivering information and, although often overlooked, face-to-face communication is a mechanism as well. Each presentation mechanism has its own characteristics and affordances that may be helpful in particular situations. For example, delivering a lecture from a podium may be an appropriate mechanism if your students are all located in the same place. In the same way, a lecture delivered over the mechanism television may be appropriate if your learners are dispersed across many time zones. The mechanism you choose can have a large impact on the level of efficiency and appeal that your instruction has.

Perhaps surprisingly, the choice of a presentation mechanism has consistently shown itself to have no determinable affect on instructional effectiveness (Clark, 1983; Lockee, Burton, & Cross, 1999). When instructional strategies and the other medium components have been accounted for, it is apparent that the presentation mechanism has little influence over instructional effectiveness. Nonetheless, there are many reasons why some mechanisms are more appropriate than others are. For example, radio is accessible to rural areas with little infrastructure; of course, the limitation of radio is that it is exclusively reliant on audio. Similarly, the advantage of the Internet is that it can transmit information of all types; the disadvantage might be that bandwidth is often limited and sporadic.

Presentation Modality

The presentation modality is different and independent from the presentation mechanism. The modality includes presentation methods such as text, audio, video, audio, animation, pictures, and illustrations, to name a few.

However, the modality chosen for instruction is likely to have a larger effect on instructional effectiveness than the presentation mechanism. For example, an audio-only description is not likely to be effective in teaching a topic such as electronic circuitry because circuits have many components that must be understood, simultaneously, in order to comprehend their relationships. Audio is a liner modality that does not easily accommodate itself to such presentations.

Changing the modality of instruction essentially qualitatively changes the content instructed. If your modality is not consistent with objectives, then you have subverted the instructional process; your instruction will have lost its congruency. By choosing the wrong modality or by selecting the modality based on convenience, instructional software ends up teaching the learner knowledge and skills that are independent of the needs of the organization or the individual. With so little time available for education, this approach squanders valuable opportunities. For example, consider the objective:

Given a diagram that includes the cell structures (cell membrane, nucleus, endoplasmic reticulum, chloroplasts, and mitochondria) and a list of those structures, in two minutes you will be able label each one appropriately, with no errors.

It is very clear that it requires a visual modality, such as an illustration. If you select audio as your modality, you would not be able to prepare the learner to accomplish the task identified in the objective.

Modalities available for instructional interventions include verbal description, visual expression, and the use of symbols. Verbal descriptions are the most common modality for traditional academic subjects. Textbooks use the printed word to convey information, while lectures use oratory to communicate the material. Verbal information is a powerful delivery form; however, it does have its limitations. For example, conveying information on any type of spatial relationship is difficult to achieve in purely text form. Visuals (illustrations, diagrams, table, charts, etc.) can be used much more effectively and efficiently to convey that type of information. Finally, the symbolic mode can be used to great effect to represent abstract notions and for when ideas need to be combined, transformed, and manipulated. For example, mathematics would be a practical implausibility without an entire system of symbols.

Some content is naturally more appropriate for a particular type of modality. Other material could benefit from a strategic combination of modalities that support one another. By ensuring that the learning goals and objectives have been carefully analyzed, a designer should be able to match modalities with the content.

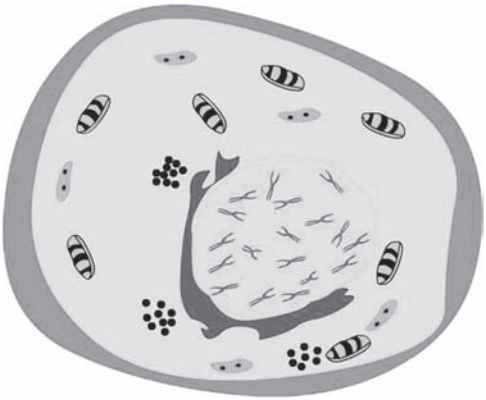
Presentation Abstraction

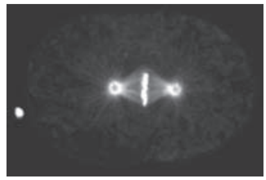
The last decision you have to make about the medium is the level of abstraction. The modalities described in the previous section can be placed on a continuum from abstract to concrete. For example, symbols or text are on the abstract end of the continuum, while an exhibit would be on the more concrete end of the continuum (Dale, 1969). You will have to decide what level of realism is required to meet your objectives. Further, each modality can be subdivided into its own continuum. For example, the image modality includes illustrations and photographs. In regard to the previous learning objective, the cells in the diagram could be photographs or drawings as in Figure 3.2.

Most learners will find the drawing easier to comprehend because it has stylized the content. The drawing has made the individual elements stand

Figure 3.2. Comparison Between Levels of Abstraction.

www.agen.ufl.edu/~chyn/age2062/lect/lect_06/lect_06.htm





out and contrast from one another. The photograph, on the other hand, is generally more difficult to decipher; however, it has the advantage of being realistic. If the learners were eventually going to be required to identify these structures under the microscope, as a practicing biologist would, they would have to be able to work with realistic images. This is another reason why making learning objectives as specific as possible, so we will know what type of activities we need to include in instruction that help the learner reach his or her goals.

The level of abstraction can also be used to create an instructional presentation. For example, if the terminal goal requires the learner to be able to identify structures in a realistic setting, it still may be advisable to begin a presentation sequence with a stylized drawing. Once the learners can identify the structure in an illustration, they then may be prepared to begin attempting to understand a more realistic photograph.

Symbols and text can also be placed on an abstract to concrete continuum. For example, the learners could be provided with an equation $(x + y)$ that is an abstract presentation of a problem, or they could be provided with a concrete verbal description of a problem (i.e., Express the total weight of Pip the mouse and Fido the dog). The concrete description is, usually, capable of being perceived by the senses and has the advantage of being easily related to one's experience. An abstract description is, is on the other hand,

challenging because it is separate from one's experience and but is often more powerful because it can be more easily connected to numerous problems.

One of Flash's advantages is that it is capable of presenting media formats representing many levels of abstraction, through a number of modalities, and delivered on a variety of mechanisms. Flash can present both illustrations (as vector graphics) and photographs (as pixel graphics) and can use modalities such as video or animation to present those illustrations. Finally, Flash can be distributed through presentation mechanisms such as the Internet or on CD.

Instructional Strategies

In each of the learning domain chapters (Facts, Concepts, Principles, and Procedures) the following instructional strategies will be examined: (1) attention management, (2) cognitive load management, and (3) structural management. These management strategies are aligned with the three primary memory structures: (1) sensory, (2) working memory, and (3) long-term memory. Strategies in those categories help focus the learners' attention, efficiently use cognitive resources, and generalize and transfer the content to new situations. Each of these instructional strategies requires a unique implementation explained below.

In any instructional interaction, you will have to decide whether you will teach directly and explicitly or whether you will ask the learner to learn by discovery. The direct approach is the most familiar general strategy and consists of presenting the learner with descriptions of rules and the provision of examples. This book primarily guides you in creating direct online learning.

The other option is to have the learners discover the relevant relationships themselves. This is called a "discovery" or a "generative" strategy. The discovery approach can often be motivational for the learner. In addition, it can lead to more in-depth learning. On the other hand, the discovery approach requires more time and can often lead to the development of misconceptions; it is easy for learners to miss connections and relationships.

Ausubel (2000) points out that a completely discovery-centered approach is rare; a successful learning experience almost always requires that the

learners be provided with substantial support and guidance and not be left on their own. Kirschner, Sweller, and Clark (2006) suggest that most evidence indicates that a direct approach leads to more successful outcomes. Regardless of the approach you choose, remember that both direct and discovery strategies require guidance.

Online learning with Flash, generally lends itself to direct strategies; however, as we move into the specific chapters on learning domains it will be apparent that both general strategies should be considered at various times to generate quality instruction. One of the benefits of online learning with tools such as Flash is that you can provide different levels of assistance to different learner and allow them to have control over which topics they pursue and how much support accompanies them.

For example, to engage learners in a discovery strategy you could provide them with a series of objects and ask them what they have in common or you could give them a problem to solve. You could ask them, "What is the most efficient route for delivery trucks to follow to get from point A to point B?" They would then have to discover the solution; optimally, they would take into account geography, geometry, traffic flow, fuel consumption, and cost, along with a myriad of other variables.

A direct approach would be simply to tell them the most efficient route and explain the rationale why. A middle ground between the two approaches would be to use a worked example, which presents the problem as well as the variables involved and walks the learner through the logic of reaching the conclusion. You then ask the learner to solve un-encountered yet similar problems.

Attention Management

In teaching each learning domain, you will have to consider how to focus the learners' attention and how to assist their cognitive processing, and how to help them in assimilating new content into their long-term memory structure. You need to guide the learners' attention to what is under discussion at any particular time. This can be accomplished by a number of methods, including (1) informing the learner of the learning objectives, (2) informing the learner of an objective's classification, (3) highlighting

important aspects of the presentation, and (4) manipulating time and space in a presentation.

Inform the Learner of Objectives Instructional goals and objectives are the result of a careful task analysis. The entire instructional interaction is dependent on these objectives. Any instructional intervention must be congruent with these objectives; in other words, learners must specifically address them, and presentations and practice must demonstrate the content in such a way that it supports the objectives. You must inform the learners of the objectives and inform them of the relevant learning domains; this helps them focus their attention.

Because you will have spent so much time developing these in the planning phase, you will want to use them for maximal advantage. Not only do goals and objectives help guide you as a designer and a developer, but they also will help your learners orient themselves to the material. For example, you would inform learners of the objective "to be able to *select* an example" of a particular concept. By doing so, you allow them to focus on that behavior; they can conserve their time and focus their attention by not pursuing a different objective such as, "to be able to *generate* an example" of a particular concept.

Inform Learner of Classification Describing the objectives to the learner helps orient them to the learning task. Drawing a learner's attention to how an objective is classified can also be supportive. Each learning domain (Facts, Concepts, Principles, and Procedures) relates to the others in some way. Facts, particularly as verbal descriptions, are the elements used to describe Concepts, Principles, and Procedures. Procedures consist of verbal chains (steps) and their underlying rationales consist of Principles. Principles causally connect and relate to Concepts. These connections imply that an objective classified in any particular learning domain does not exist in isolation. It is worthwhile to spend time on a task analysis because it reveals not only the behavior that is expected, but also the learning domains that are applicable. You will have to spend some time assisting the learners with these connections by paying particular attention to prerequisites and prior knowledge, regardless of the learning goal.

Highlight Presentation The learners' attention must be guided to important aspects of a presentation. Graphics are particularly important in online learning for performing this function. For example, if you are trying to teach a learner to distinguish mitochondria from the golgi apparatus in a cell biology course, you must give them an indication of which elements within the cell you are referencing. You need some method of highlighting or pointing to those structures to build an association between them and their label. In an online learning environment, you can do this by manipulating images through tools such as Photoshop; you can impose a red arrow on an image or you can modify the color of a structure within an image to identify it.

Manipulate Time and Space Additionally, you may want to use video or animation to allow a learner's attention to focus on phenomena that are difficult or impossible to observe without those formats. For example, frame rates can be manipulated in Flash, which allows you to slow motion. There are many things that occur too quickly to see. For example, if you are studying aerodynamics, you might want to learn how hummingbirds interact with the air; this can only be done by slowing the frame rate. Likewise, if you were studying the growth of a plant from seed to maturity, you would want to manipulate time through time-lapse photography.

Cognitive Load Management

One of the most significant studies in cognitive psychology was Miller's (1956) study that revealed that a person's working memory can only hold five to nine units at any one time. Miller (1956) called this range the "magical number seven, plus or minus two." These studies are the basis of cognitive load theory, which suggest that if you ask a learner to work with more than seven items at any time, you risk overwhelming and confusing him or her.

The instructional implication is that, whenever possible, the designer should reduce the number of elements involved. There are four primary methods of doing this: (1) enhance clarity by eliminating from the instructional message extraneous, non-relevant information, (2) reduce the size of the instructional event, (3) prepare the learners to create categories

or classes so that disparate elements are viewed as sets instead of individual elements, and (4) use the environment to provide information in context so the learners don't have to remember it to perform a task.

Enhance Clarity Clarity in your communication is the first method for ensuring that cognitive load is reduced. Writing prose that is easy to understand and logically organized dramatically reduces the cognitive resources that a learner must apply to deciphering an instructional message. This allows learners to be able to concentrate on the content and not on its organization. Clarity can be enhanced by refining the message. Refining the message is an act of editing. You will have to decide what to take out and what to leave in so that your instructional message is congruent with the actions you took in the planning stage. You will need to decide what point of view to take, what voice to select, what level of audience to target, and the length of segments you provide.

Streamline Presentation Streamlining the instructional message can be further pursued by ensuring that the information presented is congruent with the goals and objectives; the designer can assist the learners by removing information that does not relate to the task. If you are tempted to provide extra information, be sure it does not confuse the learners. For example, if you are teaching someone how to fix a broken television set, you may be tempted to relate a story about the history of television. If history is not a specific learning objective and if it does not help the learner connect the new information to prior knowledge, then it may be best to eliminate that story from the instructional materials.

Reduce Unit Size Another option to reduce cognitive load is to break the content into smaller pieces. You can teach each smaller piece to mastery before moving on to the next piece. For example, an extensive procedure such as a pilot's pre-flight check could be broken down into several smaller pieces such as electronics, engines, structure, safety, crew, and so forth. Each of these categories is reducible. You can teach each of these segments individually and then, gradually, you can have a learner link them together to master the entire procedure.

Encourage Grouping The fact that our working memory is restricted in the number of units that it can process at any one time has its limitations, but it also presents an opportunity. People have evolved the ability to manipulate, abstract, and consolidate units. This is the process of conceptualization. For example, a football player must know a set of plays. Each offensive play consists of directions, in both time and space, for each of the eleven players on the field. The large number of elements involved in a play surpasses the capacity of one's working memory. However, with experience, the player learns to see the plays as a set or unit and then, instead of thinking of the actions in the play as individual elements, the player can see them as one single unit. Hierarchically classifying units into larger sets is the essence of how people are able to think.

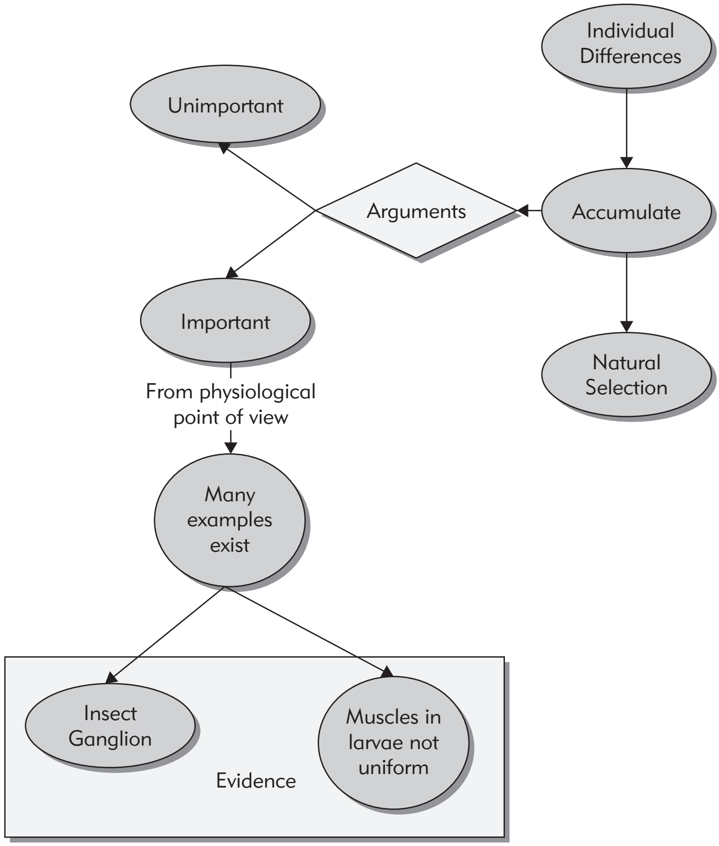
Provide Graphic Organizer The last method involves creating a user interface that provides relevant information to the learner. For example, you can assist learners in memorizing the facts related to an historical event by providing a timeline. A timeline assists the learners by demonstrating how any particular event relates to the whole. Additionally, providing the learners with an easily comprehended navigation system allows them to focus on the instructional material instead of on how to find the information that they need.

Structural Management

For a learning event to be successful, the content must be integrated into one's long-term memory structure. This is challenging because everyone has an idiosyncratic set of neural connections. However, you can assist the long-term assimilation of knowledge by demonstrating how it relates to other material. Long-term memory can be assisted by (1) mapping knowledge structure, (2) identifying prior knowledge, and (3) providing a wide range of examples.

Map Knowledge Structure You can use a tool such a concept map, a graphical arrangement of knowledge with the primary facts, concepts, principles, and procedures connected to one another through a series of lines of spokes. A concept map such as the one shown in Figure 3.3 demonstrates how information relates to other information. This may assist the learners in creating and modifying their own long-term memory structures.

Figure 3.3. Concept Map Example.



Prior Knowledge Ausubel (1963) states, "The most important single variable in learning is what the learner already knows; ascertain that and teach him accordingly." If you want to assist the learner in restructuring his or her long-term memory to accommodate new ideas, you will need to find out what he or she already knows. In an online learning environment, with applications such Flash, you may not be able to establish the learners' prior knowledge. However, you can attempt to identify common misconceptions with content and explicitly address them. This information can often be generated by conducting user tests (see Chapter 14). A pre-test is particularly helpful in deciding where to place the learner in the learning application.

Examples Finally, learning any new element of a learning domain (Fact, Concept, Principle, or Procedure) is largely a matter of determining how widely it can be applied, where it does not apply, and where another element is more appropriate. Every element must be generalized and discriminated. To accomplish this task you must provide the learners with a large number of examples. Examples should be divergent in that they show the extreme situations in which a learning domain element can be used. A set of non-examples should also be provided to help the learners discriminate from appropriate to inappropriate usages. Providing a range of examples helps the learners integrate the content into their long-term memory structure.

Summary

The important ideas in this chapter include:

- Clarity is critical to any presentation.
- Mechanism, modality, and level of abstraction all influence the quality of a presentation.
- The primary presentation strategies are (1) attention management, (2) cognitive load management, and (3) structural management.

COMING UP: PRACTICE SEQUENCES

In the next chapter, you will have an introduction to actively involving the learner. Involvement is encouraged by the creation of practice sequences designed to strategically remove support from the learners so they can eventually perform in context. The chapter provides a framework for creating quality practice sequences.

4

Practice Sequences

Guiding Questions

- What is the difference between information and instruction?
- What is the value of practice?
- What is a practice sequence?
- What role does support play in practice?
- What is the theoretical foundation for developing practice sequences?
- What type of feedback do learners require?

Chapter Overview

Instruction should be designed to evaluate and document learner activity. This book concentrates on practice-based activities that lend themselves not only to keeping the learner actively engaged but also provide evidence of a learner's progress. Unfortunately, most online learning designers do not

emphasize providing feedback. Learners need feedback to confirm their understanding. Technologies such as static web pages, podcasts, and videos merely present information. A "page-turner" type of training only delivers information and does nothing to confirm that learning has occurred.

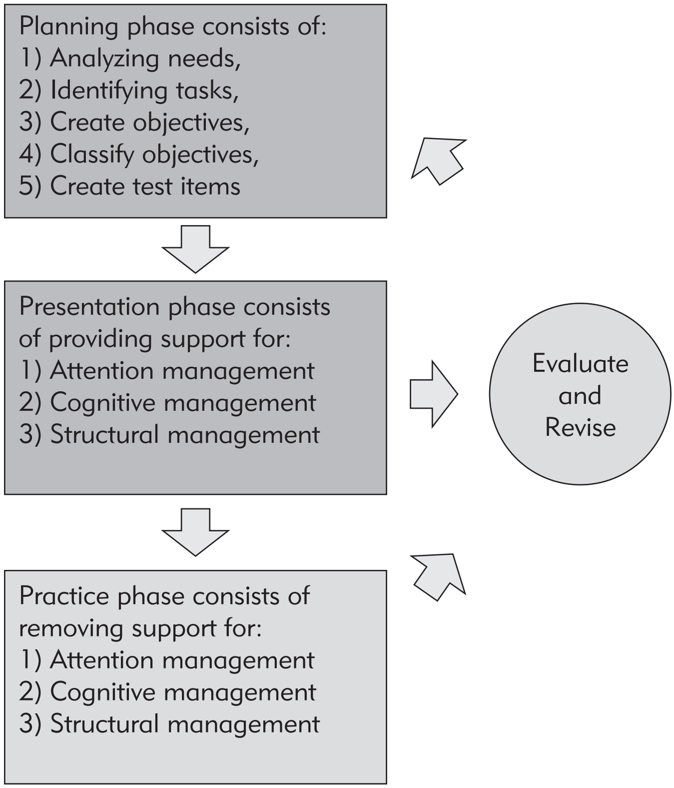
It is critical that the learners be active, and to be active they must engage in practice. There is no such thing as a passive learner. If a learner is truly passive, then he or she is not learning anything. Since instruction is a communications event, it requires both a sender and a receiver. Each partner participating in a communication event must confirm that the instructional message has been understood. Confirmation needs to come in the form of performance. Asking learners whether they have learned is rarely a productive exercise; most people simply do not have the ability to judge their level of understanding. A performance provides unambiguous evidence that learning has occurred.

By adding practice sequences, you can transform an information-centric learning model into an interactive and active one. To implement practice sequences successfully, a designer must learn how to analyze and separate instructional tasks into subtasks that concentrate the learner's attention, enable a performance, and allow for the presentation of targeted feedback.

Practice-Centric Design

In Figure 4.1, you can see that Practice is the final phase in the design process. Practice sequences are the result of careful planning and follow the presentation of content to the learner. Practice-sequences have their own attributes that, in many respects, may be counterintuitive. It is important to note that practice sequences, like their presentation strategy counterparts, are aligned with the three types of memory from the human information-processing system. However, practice sequences have the reverse purpose. Presentation strategies attempt to manipulate and augment information to support its assimilation with each phase of the human memory system. Presentations add support to make content more comprehensible, while practice sequences seek to strategically remove that support until it is no longer needed.

Figure 4.1. Practice Sequence.



As we will see, numerous choices have to be made to develop an instructional intervention, and those choices can either be the logical result of a carefully considered outcomes or they can be made capriciously. The road to quality comes with careful consideration.

Information vs. Instruction

The Internet has made the distribution of information easier than ever. It is tempting for many designers to simply present information and call it instruction. But presenting content is only one element of effective instruction. A good instructional designer knows that information is not equivalent to instruction. A complete instructional event must provide learners

with opportunities to demonstrate their knowledge and to do so in a logical sequence. These interactions are called practice.

Imagine spending hours reading text on the screen without knowing whether your effort is helping you reach your learning goals? In fact, it is difficult to find examples of online learning that do not follow this information-centric paradigm. This is unfortunate because tools like Flash are readily available that can make practice sequences easy to implement. Instruction must require learners to perform and receive feedback on the appropriateness and quality of their performance.

Instructional software based on an information-centric design model is called a "page-turner," that is, a digital book. Unfortunately, there are few advantages to reading text digitally and many disadvantages. In most cases, learners prefer to read such material in a traditional format, like a book. Reading on the screen is still difficult. Electronic text strains the eyes more than text on paper, and books are generally lighter and easier to read comfortably. The biggest advantage that computers have over paper is that they can be interactive. If online learning is not going to be interactive, then there are few reasons to justify being online at all. Unfortunately, most online learning designers do not take advantage of these opportunities.

Instruction, at a minimum, should include learner goals, information presentation, practice, feedback, and learner guidance (Merrill, 1997; Merrill, Drake, Lacy, Pratt, & ID2 Research Group, 1996). These later elements, unfortunately, require a different set of skills beyond the presentation of information. Often those called on to develop instructional materials (technical writers, multimedia specialist, and others) are not familiar with these skills. Technical writers, for example, are concerned with clarity not evidence (Rosenberg, 2000). Learners generally require assistance that helps them to focus on outcomes, reduce cognitive load, provide practice and feedback (Rosenberg, 2000).

Value of Practice

Quality instruction must do three basic things: (1) it must present information, (2) it must provide practice opportunities, and (3) it must provide appropriate feedback (Sivasailam, 2007). When information is presented to

the learner, it is critical that great care be placed on making the content clear and that the content tie directly to goals and objectives. However, the act of communication requires more than a presentation; you must provide opportunities for the learners to demonstrate their understanding. Learners must demonstrate that they have not only comprehended the message but that they have integrated it into their cognitive structures.

Learners must have an opportunity to provide evidence that they have acquired the knowledge in question. In most cases, some sort of overt performance is required. Without such a performance, learners can have a false sense of knowledge. Learners, and in fact people in general, have an enormous capacity to delude themselves about what they know and what they do not know. One of our main jobs as instructional developers is to not allow these delusions to persist. You can reduce the chances of self-delusion by careful design. Skill, the capacity to do something well, must be free from delusion. The term "practice sequence" is used to describe activities that promote skill.

A practice sequence is much more than endless repetition. Spending hour after hour on an activity such as playing the piano may not necessarily result in becoming a better piano player unless the practice is deliberate and sequenced. A practice sequence is methodical and involves specific activities followed by feedback. It has been said that "Practice doesn't make perfect; perfect practice makes perfect." Without a sequenced practice with feedback, learners may not be enhancing their knowledge or skills.

A practice sequence implies a progression, not merely repetition. When you are developing a practice sequence, you should require the learners to perform parts of a task or subtask before they are asked to produce a complete performance.

The rationale for this is that misconceptions and misunderstandings are easily targeted and re-mediated. A practice sequence makes it easier for a designer to identify a learner's deficiencies. You must make a number of decisions, including how large each practice segment should be, how much assistance should be provided in each segment, what type of performance to require, what to do in special cases, and what type of feedback to provide. You must logically assemble these elements together to create a logical sequence of practice.

Finally, a practice sequence must provide feedback to the learners. Such feedback is most valuable when it is tied directly to performance. The sooner feedback can be provided to the learners, the more effective it will be. The learners should not have to wait to discover whether their performance was adequate. The goal is to produce a system that completes and confirms the communication cycle.

You cannot present information without including practice and feedback and creating a consistently successful learning experience. Practice and feedback are key elements for turning information into instruction. You must overcome the presentation bias by internalizing that *information is not instruction*.

Practice-centric design means that learners not only receives feedback on what they do not know, but they develop a sense of confidence in what they do know, which translates into actionable knowledge. Learners' confidence in their ability is a strong predictor of their performance. The best way to become confident is to have performed in a manner that indicates mastery (Galagan, 2003). A practice-centric approach also reduces the problem of learners assuming mastery when the assumption is not warranted. Learners who overestimate their knowledge can be counter-productive in every work domain. Over-confidence in one's knowledge is a result of learning that does not provide adequate practice opportunities with high-quality feedback.

Practice Sequences

Designing practice sequences requires designers to evaluate the utility of each sequence based on the results that it produces. The goal is to select a sequence that creates instruction that is maximally efficient, effective, and appealing. To ensure that you have selected the optimal practice sequence, you will have to conduct a series of user tests. Develop a practice sequence in such a way that a natural progression of activities is presented to the learners that is appropriate with their current knowledge and skill levels.

When creating sequences, your initial goal is to create practice opportunities that provide support to the learners and to then to remove, strategically, that support. In this way, the learners can successfully complete tasks with

less and less support. Some learners and some content only require simple sequences, while others require sequences that are more complex.

Initially, practice sequences may provide the learners with a large amount of support guidance, perhaps including detailed explanations and hints. Then ask the learners to generate responses while being assisted with that extra information. The next step is to remove some of the supporting information and have the learners respond again. This process continues until the learners are able to respond without any assistance at all.

The idea of practice sequences emerges in a number of instructional theories. Vygotsky (1978), describes the difference between a novice learner in a subject area and an accomplished learner as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (p. 86). The distance that Vygotsky describes is his "Zone of Proximal Development." This distance is bridged by building appropriate practice sequences.

The same learning principle can be described in behavioral terms as providing cues and fading cues (Gropper, 1974; Skinner, 1953). By fading cues, a response can be transferred from one stimuli to another. Cue management can be considered a form of scaffolding, a process of providing instructional assistance and guidance (Wood, Bruner, & Ross, 1976). At times scaffolding may be limited to providing resources and advice, while other tasks demand a carefully crafted sequence of practice activities.

When designing an instructional intervention, one must decide how much scaffolding is required. Because each learner is an individual with an idiosyncratic history, perhaps the most important step is to ascertain what the learner already knows (Ausubel, 1963). Knowing a learner's state of prior knowledge is an important step in deciding where to start him or her in a practice sequence. If you place a learner in a stage of a practice sequence that he or she has already mastered, then it is likely that the learner will become bored and the activity will quickly become tedious. User tests can help identify the prior knowledge of typical participants (Angelo & Cross, 1993) and thus help you to design an appropriate set of sequences.

It is usually beneficial to start out with sequences that are more detailed. As a designer, you have a number of variables that you can manipulate. For example, you could modify the size of unit of performance, the degree of contextual support or cues provided, the type of actions the learner is required to engage in, and the amount of repetition. A sequence with large steps between practice events may confuse the learner, while a sequence with small steps between practice events may lead to the learner becoming bored. These interventions will be discussed in the following sections.

Designing Sequences

Consistency with Objectives

When designing a practice sequence, take great care in examining learning goals and objectives. At this stage, it is critical that the intervention be congruent with the learning objectives. The more detailed the objective, the easier it is to achieve maximal congruency and consistency. For example, the learning objective:

> *Given a pair of binoculars, on night with sky visibility at 90 percent, within thirty minutes, the astronomy student will be able to identify and list the relative coordinates of the planets Mars, Venus, and Jupiter on at least two out of three separate viewing nights.*

may be placed into a practice sequence by first telling the students a range of plausible coordinates for each planet and then widen the range of coordinated until the students are responsible for identify coordinates independently.

How Difficult the Task Is

An important challenge when designing practice sequences is to make difficult content easier. Some content is inherently difficult and although there is a degree of subjectivity as to what is difficult, difficult material generally has some common attributes. Some content *is* hard; it does not merely *seem* hard. For example, learners may find themselves having a difficult time with mathematics. They may view themselves as mathematically challenged.

However, evidence is increasing that the more likely culprit is that the learner has not developed appropriate cognitive strategies for dealing with the subject (Tobias, 1993). Often these learners do not have experience with the material. In most cases, the more experience one has with a subject, the easier it is to learn new things about it. Ausubel (1963) describes this phenomenon as prior knowledge influence and identifies it as the key to learning.

Apart from a learner's subjective and personal experience with content, there are also some objective criteria for determining whether content is difficult. As in the case of mathematics in general, abstract content is initially more challenging than content that is concrete. Even though a topic may be initially difficult, we can provide support to the learners to make the task easier.

Material that is inherently "hard" is challenging because it has a set of characteristics that make it that way. These characteristics include (1) the degree of similarity to other material, (2) the number of properties something has, (3) the volume of material, (4) how similar the material is to what is known, and (5) how long between the time of learning the material and its application. All of these characteristics should be considered when creating a practice sequence.

A sequence needs to identify to what degree these characteristics are at play and then to provide the learner with practice that compensates and adjusts for that particular characteristic. Building an appropriate practice sequence is primarily a problem-solving activity whose goal is to create conditions to establish congruency among instructional goals, the content domain, the idiosyncratic characteristic of the material, and the instructional intervention.

These "challenge" characteristics make it difficult for the learners to construct appropriate associations, make discriminations, and generalize. Challenge characteristics are present in all of the different knowledge domains (facts, concepts, principles, and procedures). Specific prescriptions are presented on how to handle these challenge characteristics in later chapters on those topics. Much of the following overview of challenge characteristic is based on Gropper's (1974, 1983) instructional model.

Similarity of Attributes

It is easier to distinguish a fish from a mammal than it is to distinguish a cat from a dog. This is because the fish and mammals are considerably different from one another, while a dog and a cat have similar attributes (i.e., furry, mammals, four legs, domesticated). Making discriminations between two classes is easier if the attributes of the classes do not overlap. That is to say, the degree to which one class is different from another makes it easier it is to tell them apart. Likewise, it is easier to generalize when the attributes are similar to one another. For example, it is easier to identify a sparrow and a robin as being birds than it is to generalize the bird concept to ostriches and penguins. The former has prototypical attributes of birds, while the later have attributes that are relatively unusual.

Number of Attributes

When instructional content has attributes similar to other content, designers must develop more involved practice sequences. They must provide more support to assist the learners in the task. Additionally, the number of attributes can make material difficult to learn. In general, the larger the number of attributes in a class, the more difficult it is to classify an instance as belonging to that class. For example, one can define a *keelboat* as a sailboat that has a keel instead of a centerboard (Wikipedia, 2007). Correctly classifying a keelboat is an easier task than correctly classifying a *schooner*, defined as a sailing boat that has sails on at least two masts (Wikipedia, 2007). Classifying a *keelboat* only requires you to keep track of one attribute, an easier task that keeping track of the two attributes that define a *schooner*.

One also must consider the number of subclasses within a class. The more subclasses, the more difficult it will be to generalize them all under the same class. For example, there are many more types of insects within the insect kingdom than there are types of mammals within the mammalian kingdom. Thus, the variation among insects is broader than it is among mammals, which makes it more difficult to classify any insect correctly.

In general, the larger the number of associations that need to be made, the more difficult the task. For example, all things being equal, a list of twenty vocabulary words would be more difficult to learn that a list of ten

words. Likewise, a longer procedure will be more challenging to learn than a shorter one. For example, the safety checklist for a rowboat is considerably shorter than a checklist for a jet airplane; thus learning the airplane checklist will be a more challenging task.

Similarity of Responses

Not only can similarity of attributes make some material more challenging, but so can the similarity of responses required. If a child chases a ball into traffic on a rainy day, a driver will have to respond quickly. However, the appropriate response will depend on whether the driver is operating a vehicle with or without anti-lock brakes. In a vehicle without anti-lock brakes, the appropriate response is to pump the break pedal quickly, but in a vehicle that does have anti-lock brakes, the appropriate response is to press the brake hard. These two responses compete with one another because they are so similar. This task is difficult and likely will require more practice than responses that do not compete with others.

At the same time, it is difficult to generate a response if it is substantially different from what it is associated with. For example, different languages have different words to represent the same concepts; it is easier, when learning a new language, to learn terms that are similar to those in one's native language. It is easy for a native English speaker to learn the Spanish term "*el pasaporte*" as an equivalent for "passport," while it may be more difficult to learn the Spanish term "*el zapato*" as an equivalent for "shoe."

Likewise, it can be difficult to produce a response where there is a false similarity. For example, a native English speaker when searching for the German word for "gelding" may mistakenly use the German term "das Geld," which means "money," simply because they sound similar. In these circumstances, extra care must be taken to ensure your instructional interventions take into account the ease and difficulty of making appropriate responses.

Prior Knowledge Interference

Prior learning may interfere with a learner's ability to make new, often more appropriate, associations. Sometimes this interference results in a persistent misconception. For example, studies evaluating Ivy League graduates on their

grasp of basic earth-science knowledge and concepts demonstrate that many misconceptions are surprisingly resistant to change (Clement, 1987). These high-achieving students studied and learned the principles behind why the seasons change. However, upon graduation they had reverted to their previous inaccurate conceptualizations. In other words, the learning did not stick because the previous conceptualizations were so strongly embedded in the learners' minds. In fields such as science education, educators have documented topics that are likely to produce persistent misconceptions. These topics are inherently difficult and required more elaborate practice sequences. The stronger the association in a misconception, the harder it will be to replace with new understandings.

Context

Providing context to a learner for a particular task can make it easier. Also, removing context can make the task more difficult. For example, asking a learner to describe the how to program a DVR is easier if the designer provides the learner with a remote control. The remote control reminds the learner of the procedures that are necessary for the job. The tool prompts and cues the learner.

The more prompts, cues, and hints you give a learner, the easier the task will be. The further you remove a learner from the context of the criterion performance, the more difficult it will be for him or her to perform. You, as the designer, can manipulate how much support in the form of context you provide. You may intentionally reduce contextual support, perhaps first providing context and then removing it to prepare learners to perform in a variety of circumstances.

Practice Sequence Methods

Creating a practice sequence is essentially a matter of strategically asking the learner to perform a series of tasks. The goal with an instructional presentation was to add support to make learning easier. Practice sequences have the opposite goal; they should be designed to strategically remove support until the learner can perform without it. These sequences, like presentations, are

associated with the human memory system. These tasks should be designed so that initially they are easy and then strategically become more difficult. As the learners become more proficient, they should be able to perform more difficult tasks until they are able to perform a task that reflects the terminal objective.

To design a sequence, you will have to create tasks that modify the following four variables: (1) modality, (2) scope, (3) learner action, and (4) support. It should be noted that these sequences are not always mutually exclusive. You may find that some practices can fit within a number of different categories. You will have to choose which sequences align with your particular learning goals.

Attention Management

To create a sequence that begins by providing support that guides the learners' attention, you should consider modality. Modality refers to the type of presentation of the practice sequence. It can include the media used or can refer to the fidelity of the presentation. A practice sequence could use sound, video, animation, illustrations, and graphics, or any combination of these. The use of these media elements will allow you to vary the level of realism presented in a sequence.

Often, a realistic practice presentation helps the learners complete the task. For example, you could make a practice task on using a computer application easier by providing realistic screen shots to show context. For other tasks, an abstraction, such as an illustration, can be most helpful. For example, when learning cell structures it is easier for a learner to identify the structures by viewing an illustration than it is to see an actual photograph taken from a microscope. A designer might begin the sequence with illustrations and end with photographs.

Cognitive Load Management

To create a sequence that begins by providing support that manages the learners' cognitive load, you should consider scope. Scope refers to the size of task to be practiced. Any task can be combined with other tasks or isolated into subtasks. As a designer, you must select a practice sequence that leads to criterion tasks. For complicated tasks, a small piece of the task can be

practiced and eventually chained or combined together with similar subtasks; all of which lead to performing the criterion task.

An additional method for managing cognitive load is to consider the type of learner action that is required. Not only can you present content through a number of different methods but you may also ask the learners to respond in a number of different ways. You can ask the learners to identify, choose, or generate a response, all of which put different levels of cognitive load on the learners. Once again, it is important that you carefully consider learning goals and objectives. If you do not conduct a careful analysis, it is likely that you will ask the learners to provide a response that is not congruent with the overall goals.

In such circumstances, it is possible that the learners will develop a false sense of mastery over the material. They may feel confident that they have the knowledge and skills required because they can answer all of the questions posed to them; however, if these questions are not congruent with the targeted skills, then the learners do not have the necessary information to make a judgment on their skill levels. For example, if the learning objective requires the learners to produce a set of coordinates for particular planets, then it is not sufficient to have them select from a list of coordinates. The selection task is considerably easier than the production task. The selection task may be included as an initial part of a practice sequence, but is insufficient, in itself, to provide evidence that a learner has mastered the learning objective.

A practice sequence that uses learner action might be implemented as follows. The first learner action is for a learner is to identify the phenomenon in question. When presented with a task, learners merely have to provide an appropriate label. For example, a selection task might require a learner to select the label "art deco" when presented with a picture of the architecture of Miami constructed in the 1920s.

The next learner action is to have learners edit the task. Editing requires that learners modify the practice task. An editing task provides learners with substantial contextual cues, which can assist in the performance of the task. For example, learners may be presented with a picture of the Chrysler building in New York City with the statement "This building's spire is in example of Futurism architecture." The learners would be asked to edit the statement

if required. If the learner were familiar with the "art deco" architectural style, they would edit the statement to "This building's spire is an example of art deco architecture."

Finally, you may ask the learners to produce a response. In a production action, a learner, perhaps with no assistance or perhaps with a number of supporting resources, will produce an answer. The production response may be further broken down into a number of question types, including fill-in-the-blank responses, short-answer, and essay questions (Flash has components to assist with each of these type of responses). This sequence begins with easy tasks and gradually asks learners to demonstrate independence.

The combinations available to a designer in creating practice sequences are limitless. For example, you could ask that the learners respond in any of the modalities previously discussed; you could ask them to provide a verbal response, create an illustration or, perhaps, a concept map, or even generate a proof or series of mathematical equations that would demonstrate their knowledge. Additionally, you could modify the standard or quality of a response. For example, for an initial practice sequence it may be acceptable for learners to respond with a misspelling. However, by the time they reach the criterion task, you may expect them to produce a correct spelling (Flash's learning components can be used to implement this type of interaction with ease).

Structural Management

To create a sequence that begins by providing support that assists the learners in integrating content into their long-term memory structures, you should consider the amount of support you provide. This is one of the easiest variables to manipulate. Support, cuing, or hints all assist the learners in completing the task. A cue in the form of verbal or graphic hint can be help. Once a hint is introduced, you can strategically remove it. You can fade cues, and you can diminish their resolution or you can remove them altogether. By your gradually removing these cues, the learners will begin to respond to the remaining information. Additionally, you may provide cues and then ask the learners to perform a task after a time period has passed. The time between when learners receive support and when they can perform independently is a good indication of their level of mastery.

Practice Sequence Example

For this example, we want to determine what type of practice sequence would be appropriate to learn the concepts "Vector" and "Scalar." We need to begin by analyzing their characteristics. That analysis would look something like this:

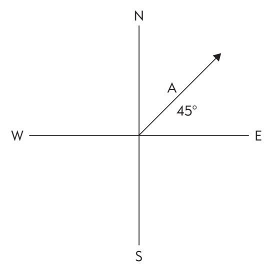
> A v*ector* is an object defined by both magnitude and direction; in contrast to a *scalar*, an object with magnitude only (Wikipedia, 2007). Both vectors and scalars have the attribute of magnitude, but differ in the requirement for direction.
>
> *Scalars* are quantities that are fully described by a magnitude (or numerical value) alone.
>
> *Vectors* are quantities that are fully described by both a magnitude and a direction.

Table 4.1 demonstrates how a practice sequence that manipulates different variables might be developed to teach the concepts *scalar* and *vector*. For example, you may decide to create a sequence by manipulating the modality. You could begin by asking the learners to perform Task 1A; once they have been successful with that task, you would ask them to perform Task 1B, and then, finally, Task 1C. As an alternative, you may want to give the learners an opportunity to perform the entire set of A tasks and the intermediate B tasks and, finally, the C tasks. You have an unlimited number of sequencing options; the important thing is to create a progression from easy to difficult task that gradually allows the learners to perform at levels closer to the task required by the terminal objective.

Table 4.1 only shows three tasks in each sequence, but a practice sequence could be shorter or longer. For example, learners may require several intermediate-level tasks before they are prepared to try an exit task. Likewise, learners may have mastered the terminal objective; in that case, they are ready to attempt the exit task immediately.

This example is somewhat artificial because the subject matter is not particularly complicated and, in most cases, it would not be necessary to produce such detailed sequences. However, the concepts "scalar" and "vector" do give us a chance to explore potential practice sequences. Also note that that

Table 4.1. Practice Sequence.

	Initial Task 1A	*Intermediate Task 1B*	*Exit Task 1C*
Attention management: Modality	Concrete and Familiar: Which of the following expresses the idea of a vector quantity? A. The pitcher threw the ball to the catcher. B. The temperature rose to 80 degrees.	Concrete: The scenario below reflects which quantity concept? While driving to the store, Anne traveled a total distance of 4.4 miles. Her trip took eight minutes. What was her average speed? A. Scalar B. Vector	Abstract: Which of the following expresses the idea of a scalar quantity? A. average speed $= \frac{\text{distance traveled}}{\text{time traveled}}$ B. $y = 2x + 3$
Cognitive load management: Scope	5 meters is an example of a sc__ar quantity.	The well is 20 meters from the farm house on the right side. This is an example of a V____ quantity.	A vector quantity has both_____and_____?
Cognitive load management: Learner Action	Recognize: Which of the following is an example of a vector quantity? A. 20 degrees Celsius B. 5 miles, North	Edit: Modify the statement below so that it is a scalar quantity. The train was running at 35 miles per hour and heading North.	Produce: Make a sentence describing the quantity in this picture. 
Structural management: Support	A vector quantity has both direction and magnitude. For example, a stone dropped off a cliff has a trajectory and a speed. A computer disk has 1 gigabyte of memory. Is this a vector quantity?	A vector quantity has both direction and magnitude. A rocket is shot up into orbit. Is this an example of a vector quantity?	You are told that light travels at 299 792 458 m/s. Is this an example of a vector quantity?

these methods are often intermixed. For example, you could use a modality sequence at the same time as a response sequence. The tasks in the table are merely examples; you could implement each variable in a multitude of ways.

When using these sequences, you would ask the learners to complete the initial practice task, then the intermediate, and finally the exit task, which represents the criterion performance. At each step, you give the learners a task that is more difficult than the previous one.

Repetition

Finally, you may modify the frequency of practice. The repetition variable is so obvious it does not warrant a place in Table 4.1; however, it is often an easy and productive method of increasing learning. Simply asking the learners to perform a practice sequence repeatedly can be very effective in learning domains such as procedures and facts. Time on task, or simply spending more time on difficult content and less on easier content, is an instructional strategy that consistently demonstrates positive results (Brophy, 1988). As mentioned previously, repetition should be a part of a strategically designed sequence if it is to be optimally used.

Special Cases

The previous description of strategies provides a foundation for creating practice sequences. However, some circumstances require more extensive practice sequences. For example, when working with the conceptual learning domain, providing examples to the learners is particularly important (see Chapter 9). You should take special care to provide a variety of examples and to vary examples as to how similar they are to the prototypical example.

It is important, particularly with examples, but applicable with any practice sequence, that you avoid repeating identical tasks. Repetition is an important principle; however, the individual tasks should vary. The idea of a practice sequence is not to pound the information into the learner's head but to create experiences that allow the learner to use the content in diverse ways.

In some situations, you may decide to have the learners perform the complete exit performance first and then begin at the initial practice task. This method is called backward chaining. This strategy is effective because

you show the learners, early on, what a complete performance will look like. Even if they are not successful, they will have a model of what their goal is. Another, advanced strategy might be to ask the learners to produce a common error; by producing an error, the learners will more easily recognize it if it appears in a later performance.

Feedback Modalities

Regardless of the type of practice sequence you develop, you will have to pay special attention to how and when you provide feedback to the learners. Feedback is any communication that informs learners of the accuracy of their actions (Mory, 1996). Feedback makes a practice sequences interactive. Feedback provides critical information to the learners as to whether or not they have responded appropriately. Without this confirmation, learners are incapable of adjusting and modifying their conceptions. An archer can shoot arrows at a target all day long, however, if he or she is blindfolded, the archer cannot see the target and will never improve. Only by seeing the arrow hit or miss the target will someone develop an understanding of how to improve his or her performance.

As with the practice sequence variables, you can provide feedback by a number of modalities. These modalities include simply confirming that the learner was correct or not, providing a description of the correct response regardless of whether the learner was right, and elaborated feedback that provides and explanation as to why a response was correct or why it was incorrect (Mory, 1996). You will have to decide which of the feedback options best assists your learners in meeting the learning objectives. Table 4.2 describes these options.

You may further categorize feedback by its degree of automation. You may entirely pre-program feedback, as it must be in a computer-based instruction tutorial, or you can provide unique communication, such as a conversation with a professor, or it can be a combination of both practices. When using a tool such as Flash, you can pre-program feedback through the use of learning components, or you can easily have the learner's response sent through e-mail to an instructor (see Flash guides). The method you choose to provide feedback depends on your learning goals and objectives.

Table 4.2. Methods for Providing Feedback.

	Confirmation	*Description*	*Elaboration*
Tasks	Which of the following is an example of a vector quantity? A. 20 degrees Celsius. B. 5 miles, North.	Which of the following is an example of a vector quantity? A. 20 degrees. Celsius B. 5 miles, North.	Which of the following is an example of a vector quantity? A. 20 degrees Celsius. B. 5 miles, North.
Learner Response	B	B	B
Feedback	Correct	Correct, 5 miles is a distance and North is a direction	Correct, 5 miles is a magnitude and North is a direction. A vector quantity requires the presence of both of these attributes. 20 degrees Celsius is incorrect because it expresses a magnitude but no direction. 20 degrees Celsius is considered a scalar quantity.

The choice of feedback type is another design decision. You will have to balance the value of a particular feedback type with the time it takes to design and develop it.

Unfortunately, designing practice sequences is not as straightforward as designing presentation strategies. Practice sequences do not neatly align with the learning domain categories (Facts, Concepts, Principles, and Procedures). You will need to examine the individual characteristics of learning objectives in order to appropriately select and apply a practice sequence.

Summary

The important ideas in this chapter include:

- Practice sequences allow the learners to be active participants in their own learning.
- Practice sequences should be designed to remove support.
- Designers have to use their creativity to develop quality sequences.
- User tests are essential activities in sequence development.
- Strategies for practice sequences can be aligned with the human memory system.
- Appropriate feedback must accompany a practice sequence.

COMING UP: FLASH

In the next chapter, you will be introduced to the Flash development program. You will learn what Flash is and why is it an ideal platform for delivering practice-centric instruction. You become aware of what Flash is capable of in terms of presentation and interaction, as well as what metaphors it uses and how it has evolved into the premier application for online learning.

5

Flash

Guiding Questions

- What is Flash?
- Why is Flash ideal for a practice-centric instruction?
- What is ActionScript?
- How does Flash interact with other programs?
- How can you distribute Flash applications?
- What metaphor does Flash use?
- Why is Flash ideal for web distribution?
- How does Flash animate?
- What is the principle of reuse?

Chapter Overview

In this chapter I will review the Flash software and describe why it is the most appropriate software instructional software applications. The strengths and weaknesses of Flash will be explored, and the software will be compared and contrasted with competing alternatives. After reading this chapter, you will understand how Flash can play a prominent role in online learning.

What Is Flash

Flash is a multimedia authoring system produced by Adobe Systems. Flash was formerly a Macromedia product; however, Adobe Systems merged with Macromedia in 2005 and has brought Flash into its family of software.

The name Flash refers to the player, as well as to the application development environment. The player and development environment are distinct entities. The application development environment is the software that allows you to create Flash applications. Flash applications can be published as .swf files, which can be distributed over the Internet. The Flash player is required to view these .swf files. The player is available for free to anyone. To work through the examples provided in this text, you will need to have access to the Flash Application Development Environment. This software is not free, although Adobe Systems does offer a thirty-day free trail, which can be downloaded at www.adobe.com/downloads/.

As Flash has developed, a number of versions have been produced. This text uses the CS3 Professional version. However, all of the features demonstrated should work if you are using Flash Version 8.

Flash was originally developed as a tool for online animation. It was designed to use the power of the computer to interpolate a series of images between two graphics, creating the illusion of motion without forcing the user to create each step or cell of an animated display as in Figure 5.1.

This ability is a huge bandwidth saver and has helped make Flash one of the most ubiquitous tools on the Internet. Flash enhances html and other web delivery standards by making it easy to deliver robust content over the Internet while using relatively little bandwidth. However, Flash is no longer merely an animation tool; it has evolved into a comprehensive interactive multimedia tool that is as powerful and flexible as any multimedia development platform available.

Figure 5.1. Cell Animation.

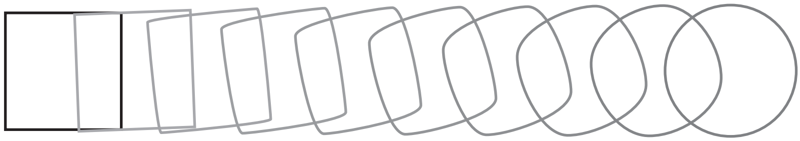


Figure 5.2. Flash Timeline

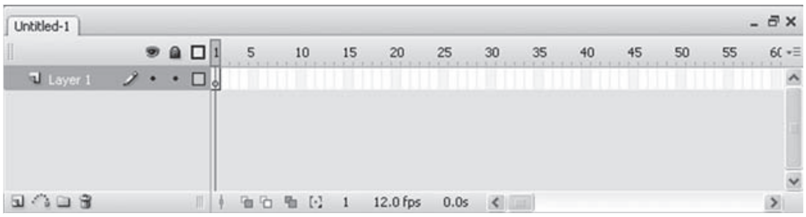
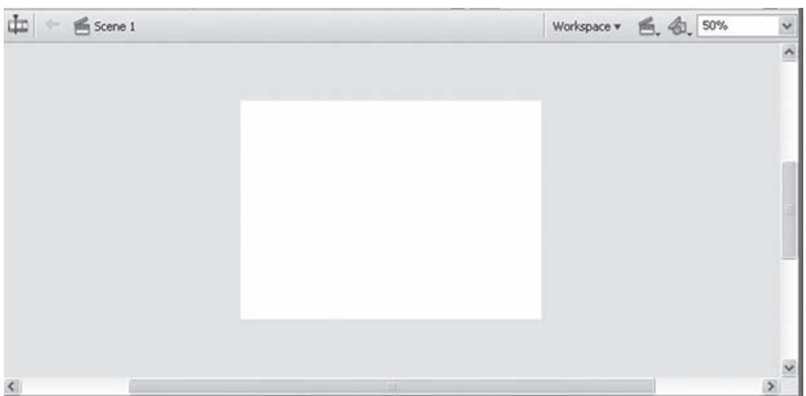


Figure 5.3. Flash Stage



Flash uses a timeline and stage metaphor. The timeline in Figure 5.2 moves from left to right. Any object placed on the timeline will appear on the stage until it is removed.

In the same way, any object placed on the stage, as shown in Figure 5.3, will be indicated on the timeline until it is removed.

Flash Capabilities

Flash has enhanced its animation capabilities with powerful programming and interaction tools. Flash's scripting language, ActionScript, is a robust and well-developed language, which provides a solid platform for programmers. ActionScript works well with technologies such as PHP, which allows actions within a Flash application to be recorded in online databases. Database connections allow the learners' actions to be tracked and documented.

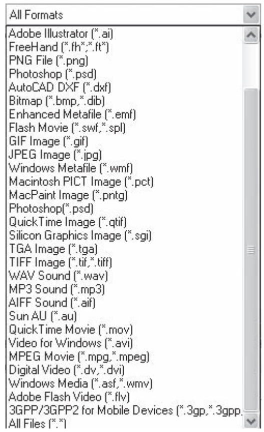
Although this book does not focus on programming, there are times when short pieces of ActionScript are helpful. ActionScript allows the interactivity to be introduced into Flash through the implementation of variable, conditional statement, loops, and functions. ActionScript is similar to JavaScript in syntax and experienced JavaScript users should not have trouble using it.

There are now two versions of ActionScript that are widely used: ActionScript 2.0 and ActionScript 3.0. There are similarities between the two versions, but there are also substantial differences in syntax. In this text, ActionScript 2.0 will be used because it is applicable to Flash 8, as well as Flash CS3. If you are using Flash CS3, be sure to select ActionScript 2.0 when you work through the Flash guides.

For the non-programmer, or for the programmer who has other things to do, Flash offers a comprehensive set of pre-built components that provide capabilities such as learning interactions that can be tailored to one's specific needs. For example, Flash comes with a set of "learning interactions" that allow the developer to create test questions such as multiple choice, true/false, and drag and drop. These components do not require any programming, which makes them easy to use regardless of one's experience level.

The software for developing Flash modules is organized in such a way as to make it accessible to the novice developer, while its capabilities are powerful enough to accommodate programmers and multimedia experts. In addition to allowing programming through ActionScript, Flash can incorporate sound, video, and other multimedia. Flash can display media in a number of forms and formats, including QuickTime, WAV, AVI, and many more. Figure 5.4 presents the types of format that are acceptable for Flash.

Figure 5.4. Acceptable Formats for Import into Flash



Flash's ease and power make it the tool of choice for implementing instructional software. Of particular importance to online learning developers is that the Flash player can read Flash files on just about any operating system (Mac, PC, and Linux) with just about any web browser (Firefox, Internet Explorer, and Opera). Flash is perhaps the most ubiquitous application on the Internet, being accessible to over 99 percent of Internet users. Flash's ubiquity also enhances its consistency. With Flash, developers can be confident that they can provide the same user experience to every online learner. This standardization enormously increases the efficiency of online learning development.

Flash files come in two forms .fla that can continue to be edited by the authoring environment and .swf that can be placed on a common web server for distribution over the Internet. Flash files can also be turned into independently executable .exe files that can be distributed on a CD-ROM and can be run directly on the user's computer.

Not only is the Flash player widely available to users, but developers can distribute Flash files can be done easily by hosting the Flash files on any standard web server (a computer whose function is to serve web pages to users). Distributing Flash files is as easy as distributing a web page. Flash can be

easily viewed, easily distributed, and as you will see, it is an easy environment in which to develop applications. Those attributes make it an ideal platform for online learning.

The Internet is the medium in which online learning is delivered. The Internet is designed in such a way that users with varying types of bandwidth connections can participate, although with faster or slower results. As an online learning developer, you may have learners with high-speed broadband access, and you may have learners with more modest connections. The implication is that reducing bandwidth is an important consideration so that all of your learners have a similar experience.

Fortunately, Flash is designed to minimize bandwidth consumption on a number of fronts. Flash is primarily a vector-based program, which reduces file size considerably. Flash is also designed on an object-oriented model, which allows for the reuse of elements within Flash at little or no extra cost in bandwidth. In fact, Flash has a system for storing the objects that it uses on the client's system so they do not have to be reloaded to play; the result is a significant savings in bandwidth.

Bandwidth can be minimized in Flash through three primary methods: (1) reduce, (2) reuse, and (3) recycle. Graphics used within Flash can be reduced by transforming them into vector graphics. Flash handles both vector and raster graphic types. Raster graphics are images that are displayed through a collection of individual pixels. Photographic-type images are almost exclusively of this type. File formats such as .gif and .jpg are common raster formats. Figure 5.5 is an example of a raster-based graphic.

Flash also handles vector graphics; in fact, Flash prefers vector graphics because they require dramatically less bandwidth to deliver. Vector graphics are described by mathematical equations that define a series of points, lines, and shapes. For example, a rectangle can be described by its position on the screen and its height and width. Figure 5.4 is an example of a vector-based graphic.

Vector graphics have the added advantage of their size being infinitely manipulatable without losing resolution or requiring additional bandwidth. They can be rotated, enlarged, and twisted while keeping their resolution. For example, in Figure 5.5, the image has become pixilated when its size was

Figure 5.5. Raster Graphic.

Figure 5.6. Vector Graphic.

increased; however, Figure 5.6 has remained clear. There are some graphics that work best as raster graphics and others that can be converted to the vector type without losing the intended message. So whenever possible when using Flash, convert graphic files to the vector type.

Bandwidth can also be minimized through the principle of reuse. Flash has elements called "symbols" that allow graphics (and other elements) to be reused. Normally, when a graphic is copied and pasted, two separate copies now exist. With symbols, a graphic does not need to be copied. Instead, it is instantiated. This means that the instances share the properties of the original but are not copies; if you change the original symbol, the instances will also be changed. This process is demonstrated in Figure 5.7.

Finally, graphics can be recycled by modifying symbols. For example, some properties, such as size, can be modified in an instance without affecting the original symbol. In Figure 5.8, you can see how a symbol can be recycled.

Finally, Flash uses a feature called progressive download. Progressive download allows you so manipulate bandwidth by using a bit of choreography (Moore & Lockee, 2000). Flash begins to download and present

Figure 5.7. Symbol Reuse.

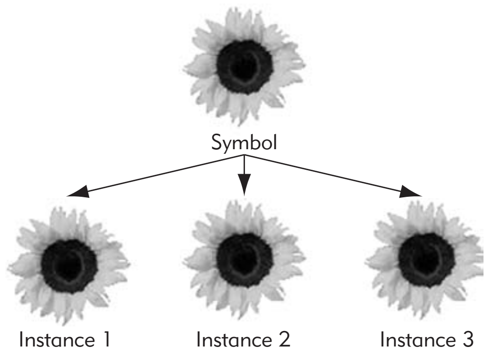


Figure 5.8. Symbol Recycle.

material to the learner as it arrives. That way the learner can instantly begin to interact with the software. By placing some low bandwidth items early in the application, such as text and vector graphics, the system can continue to download external files such as video without the learners having to wait.

The result is that the same amount of data is transferred, but the learners can begin using the application instantly.

Flash and Learning

From the instructional side, Flash offers you the ability to create online learning applications that are ideally suited for creating a quality learner experience. Learners can:

- Repeat the application endlessly
- Go at their own pace
- Receive immediate feedback
- Keep track of their progress
- Participate when and where their schedule allows

These capabilities make Flash an ideal environment for learning from both a technical and an instructional standpoint.

Topics Covered

The Flash guides included in this text cover the major features of Flash's Integrated Development Environment. These features include:

- Panels and interface
- Drawing and graphic tools
- Layers and timeline
- Basic animation
- Buttons and interactivity
- Scripting basics
- Movie clips and symbols
- Complex animation
- Multimedia

Summary

The important ideas in this chapter include:

- A description of the Flash software
- The Flash software interface and tool set
- Flash features that make it a powerful platform for online learning
- Flash features that conserve bandwidth

COMING UP: GETTING STARTED WITH FLASH

The next chapter introduces the Flash interface. You will be introduced to the Flash tool set and learn how to manipulate and tailor that tool set for your needs. You will begin working with the timeline and stage to manipulate time and space.

6

Getting Started with Flash

Guiding Questions

- What are the primary elements of the Flash interface?
- How can you set Flash's document properties?
- What is the Flash stage?
- How do Flash's drawing tools work?
- What is the Property Inspector?
- What is Flash's Timeline?
- How do you navigate Flash's Timeline?

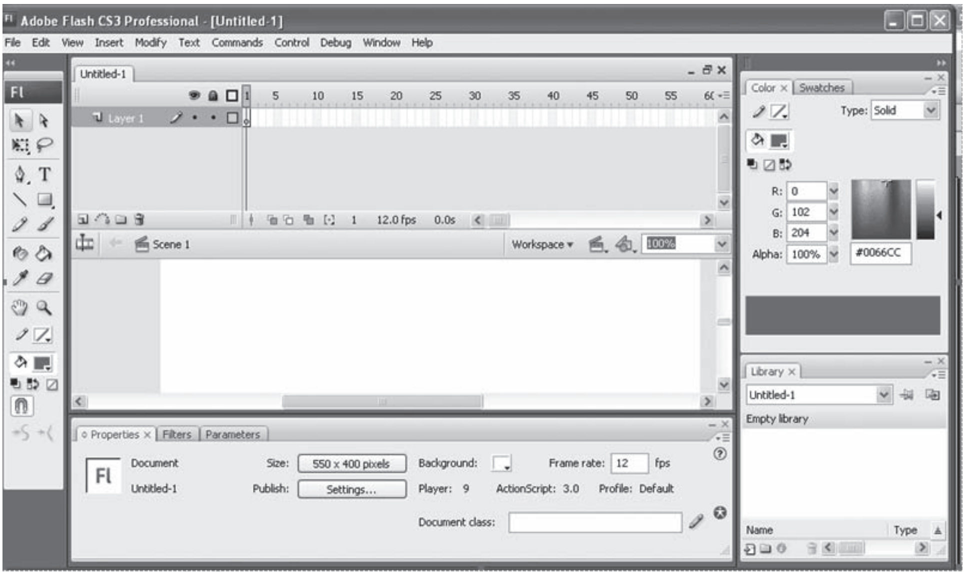
Chapter Overview

In this chapter, you will be introduced to the Flash interface.

Basic Flash Interface

Before we start, here's a quick introduction to the Flash interface.

Unified Screen



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

The Menu Bar is the primary interface with Flash. All of the functions in Flash are available through the Menu Bar. It is worthwhile to explore each Menu Bar option to familiarize yourself with Flash's capabilities.

Menu Bar

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The tools in the Toolbar are used to manipulate the items on the Stage.

Toolbar

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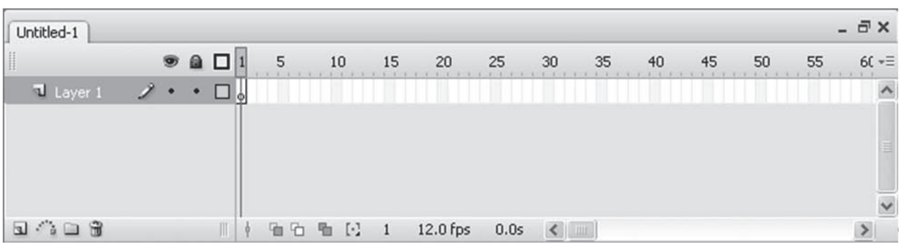
Flash uses a Timeline to describe when events occur over time. Flash expresses actions in frames per second.

Timeline



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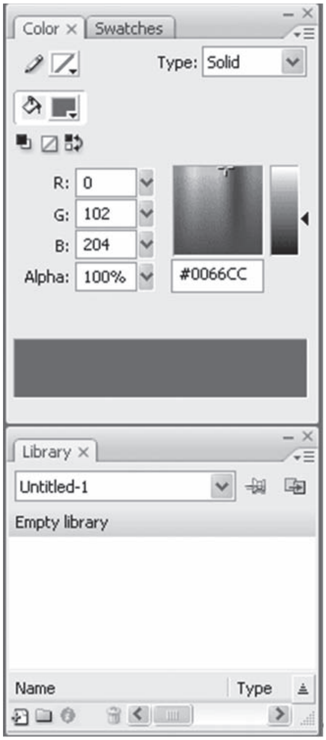
Flash uses panels to provide detailed information on a specific part of the application. For example, the Color panel below allows you to manipulate Colors, while the Library panel displays reusable elements in Flash; other panels include the Actions panel and Align panel.

Panels



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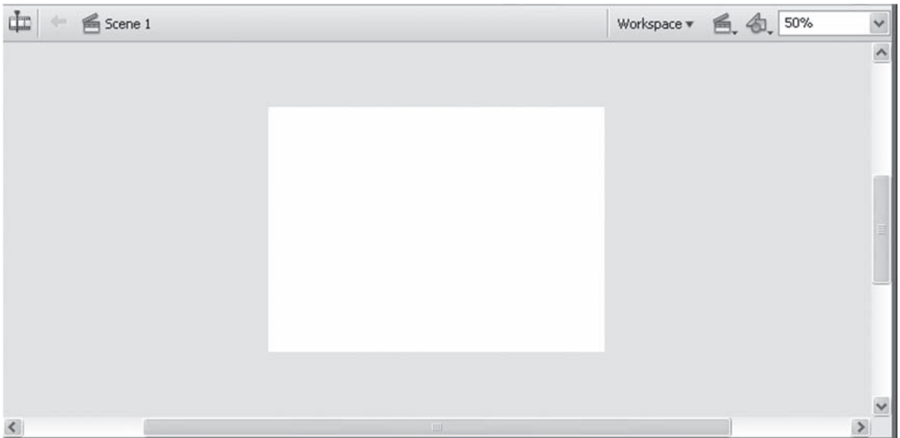
The Stage is where the action occurs in Flash. The Stage holds all of the visual elements that your users will see, but only one frame at a time.

Stage



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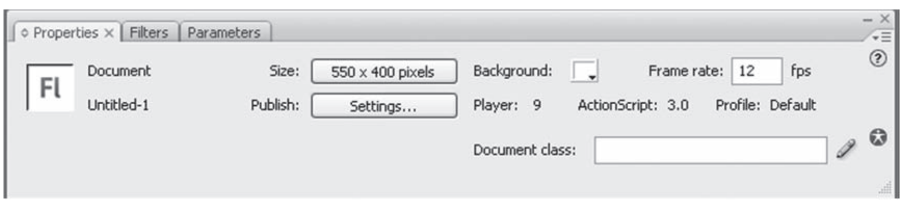
The Property Inspector gives you a method for manipulating the characteristics of all of the tools in the Tool Panel. Whenever you select a tool, the Property Inspector will change to reflect the change.

Property Inspector



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Summary

The important ideas in this chapter include:

- The Flash interface and its metaphor
- The Flash tools set
- Tailoring the Flash tool set
- Working with time and space in Flash

COMING UP: FLASH GUIDES

The next chapter presents a series of Flash guides. These guides demonstrate how to implement the most commonly used Flash techniques. They include topics such as, drawing, dynamic text, tweening, motion guides, masking, sound, movie clips, and buttons, among many others. Each guide provides a step-by-step demonstration, as well as hints on how to use the technique for instructional purposes.

7

Flash Guides

Guiding Questions

- How do you use Flash's drawing tools?
- How do you reuse elements within Flash?
- How do you manipulate text within Flash.
- How do you create animations with Flash?
- How do you allow the user to interact with Flash?
- How can you incorporate Sound within Flash?
- How do you create learning interactions and test items within Flash?

Chapter Overview

In this chapter, you will be presented with a series of Flash guides. These guides have been designed to be independent of each other, so you should be able to go directly to whichever guide addresses the issues you are working with. However, all of the skills in each of the guides are necessary to build a

minimal level of competence. You should work through each guide at least once, and thereafter use the guides as a reference. Each guide is demonstrated on the website for this text: http://oak.cats.ohiou.edu/~moored3.

Note: Any keyboard shortcuts will be placed in parenthesis. Additionally, any ActionScript code will be described using the Courier font.

For example,

- From the Menu Bar *select* **Window** and then **Actions** (F9)
- *Type*

```
Section_Title.text= "Supply and Demand";
```

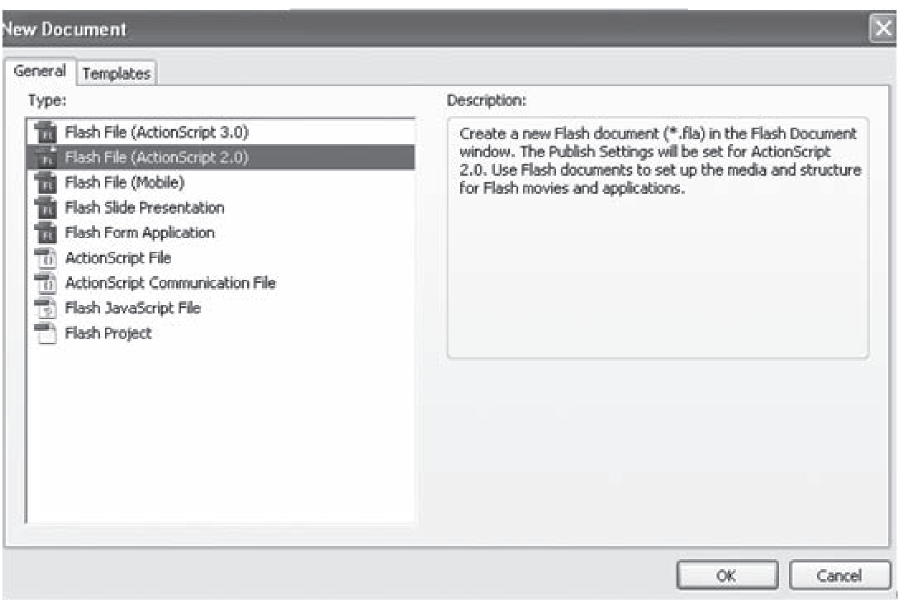
Starting Up

FLASH GUIDE FOR STARTING UP

Create New File

- From the Menu Bar, select File, then select New (Ctrl+N)
- On the New Document screen, select Flash File (ActionScript 2.0), then select OK

Note: To ensure compatibility with Flash 8, be sure to select ActionScript 2.0, all examples in this text use ActionScript 2.0.



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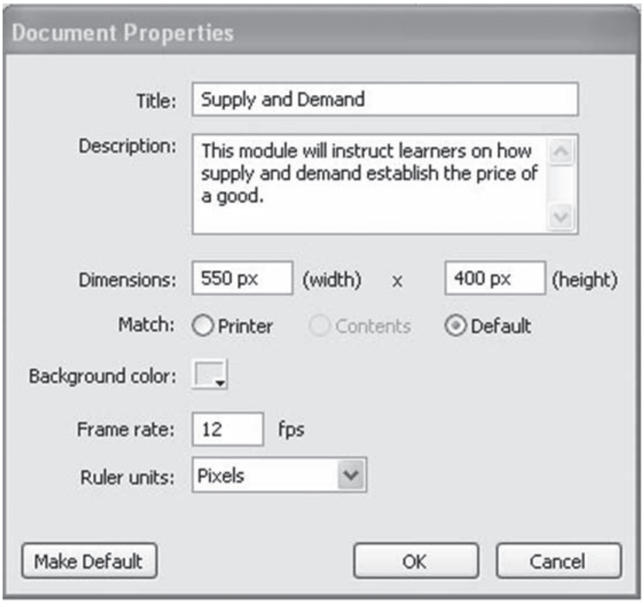
Set Document Properties

- From the Menu Bar, select Modify, then select Document (Ctrl+N)
- On the Document Properties Screen, Set the Dimensions to 550 pixels (width) and 400 pixels (height)



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: On the Document Properties Screen, you can also give your application a Title (Supply and Demand in this example) and provide a Description. Additionally, you can select a Background Color (the default is white), a Frame rate, and units for the rulers.

Note: Dimensions refer to the size of display on the computer screen. There are roughly 72 pixels (px) to each inch. In this case, the dimensions come out to be about 7.5 inches to 5.5 inches. Flash is capable of creating applications of any reasonable dimensions, even small ones for PDA and cell phones. You want to choose a dimension that will adequately allow you to present your content, while being small enough to be able to be viewed on the largest number of screens.

Note: Frame rate refers to how many frames are displayed per second when the application runs. This rate is particularly important when animation is being rendered on the screen. A frame rate of 12 is the default settings and is adequate for most Flash applications. The higher the frame rate, the higher the resolution; however, at some

point extra frames per second offer diminishing returns. For example, movies at the theater run at 24 frames per second and television runs at 30 frames a second.

Working Spaces

Note: These spaces graphically separate the screen so that the learners will consistently receive certain types of information in the same place. Interface consistency helps the learners learn by making it easy for them to orient themselves to the application; once they have learned where information is located, they can focus their cognitive resources on the content and not on navigation.

Label Layer

- Double click on the Name Layer 1

Note: Layers separate elements in Flash so that they can be quickly found and manipulated independently. They also establish a hierarchy among elements. Elements on layers near the top of the timeline will appear in front of elements on layers below.

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- Type "Interface"

Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Turn on Rulers

- From the Menu Bar, select View, then Rulers

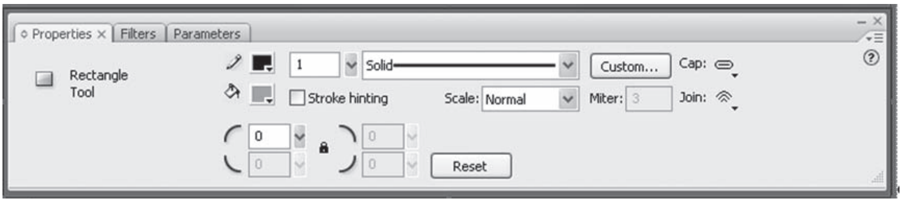
Note: Rulers are only present while you are in development mode (the end-user will never see these). Rulers are important because they assist you in lining up the elements on the screen for a clean, professional appearance.

Create Regions

- From the Toolbar, select the Rectangle Tool 

Note: Your cursor will become a cross when it is on the Stage.

Note: Each tool has its own version of the Property Inspector.

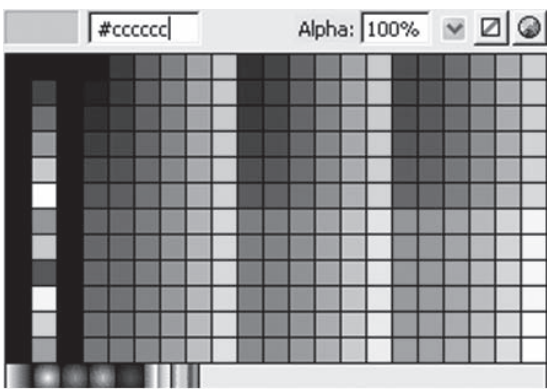


Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: You will be drawing several boxes with different properties. In the Rectangle Tool's Property Inspector, you can modify the color of the stroke (the stroke is the outside edge of the Rectangle) and the interior, the width and type of stroke, and the curve of the edges.

Change the Color of the Interior

- In the pop-up color panel, select the paint swatch and set the color to #CCCCCC.



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: #CCCCCC is a hex triplet. A hex triplet is a six-digit, three-byte hexadecimal number. Each byte describes a color in the hexadecimal system. The important principle is that if you want to match, exactly, the colors from one part of the application to another, you should pay attention and copy the hex-triplet number. In this case the hex-triplet for gray is #CCCCCC.

Note: Colors can be chosen from the Color Palette or the "Hex" code can be used. It is recommended that you use the Hex code because there are millions of colors available that often look the same on some monitors, if you use the numeric designation of a color, you will be assured that the colors you choose will always be the same.

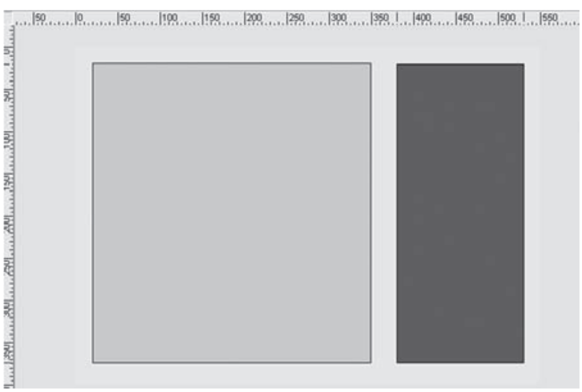
Draw the Rectangle

- Position your cursor on the stage and at 20 pixels on the X axis, and 20 pixels on the Y axis. Click and drag the Rectangle to 350 pixels on the X axis and 375 on the Y axis.

Note: The X coordinates are on the horizontal axis and have positive numbers from left to right. The Y coordinates are on the vertical axis and have positive numbers from top to bottom (this is different than most graphs you may be familiar with, which have positive numbers from bottom to top).

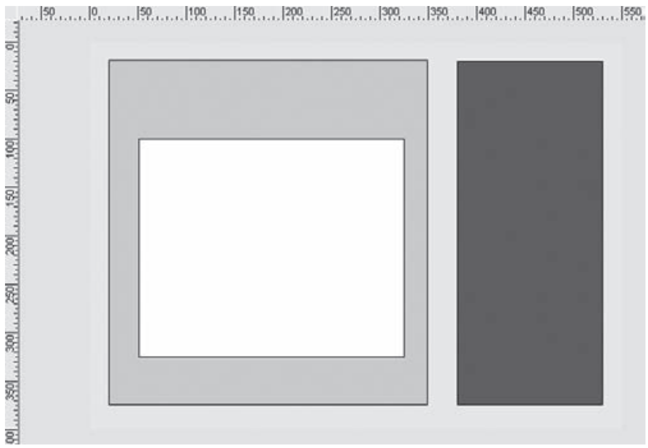
Draw Second Rectangle

- Draw a second rectangle from (375X, 25Y) and (525X, 375Y) with color #0000FF



Draw Third Rectangle

- Draw a third rectangle from (50X, 100Y) to (325X, 325Y) with Color #FFFFFF



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Summary

The start-up procedures apply to any Flash application. This guide demonstrated the development of an interface. An interface provides learners with a consistent framework for finding information. You should take great care to place the same types of information consistently on the screen; doing so reduces the cognitive load on the learners.

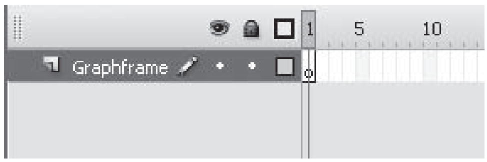
Drawing Tools

Flash is a visual medium. Any time that you are presenting information to the learners, you are likely to be using the drawing tools. All buttons and movie clips begin as simple graphics created with drawing tools. To improve the clarity and professionalism of your applications it is important to become familiar with these tools. Of particular importance is to become proficient at copying and pasting graphical element, modifying and editing them, and using the rulers, grid, and alignment functions to position elements on the screen appropriately. Graphics enhance an instructional presentation because they can demonstrate relationships in space and in time.

FLASH GUIDES FOR DRAWING TOOLS

Draw Graph Frame

- *Create* new **Layer** and *name* it “GraphFrame“



Note: It is a good idea to place each element that you work with on its own layer. This makes it easy to find and edit these elements. Be sure to name a layer with a label that makes it easy to identify.

- *Select* the **Keyframe** on the “GraphFrame“ layer
- *Select* the **Line** tool from the tool sidebar 
- In the line Property Inspector, *set* the **color** to **#80A244**, *set* the **stroke** width to 4

Note: The stroke is width of a line.

- Turn on Rulers

From the Menu bar select the **View** and then **Rulers**

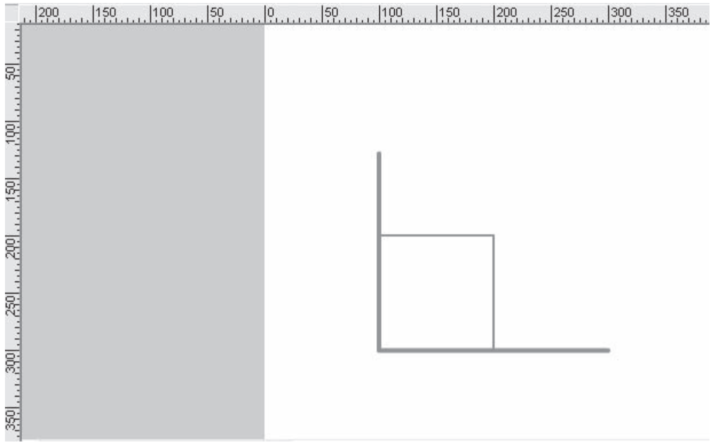
Note: The rulers will assist you in implementing specific coordinates.

Note: the x coordinates are represented on the top of the stage from left to right; the y coordinates are represented on the side of the stage from top to bottom.

- *Draw* a **line** from (100X, 125Y) to (100X, 300Y) and *draw* another from (100X, 300Y) to (300X, 300Y)
- *Change* the **stroke** width to 2

Note: Changing a line’s stroke width changes its emphasis.

- *Draw* a **line** from (100X, 200Y) (200X, 200Y) to (200X, 300Y) (200X, 200Y)



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Draw Demand Curve

- *Create* a new **layer** and rename it "Demand"
- *Change* the **color** of the Line tool in its Property Inspector to #000000

Note: Colors can be chosen from the palette or described through hexadecimal notation; in this case #000000 represents black.

- *Draw* a **line** from (150X, 250Y) to (225X, 150Y)
- *Select* the **Transform** tool 

Note: The Transformation tool can be applied to any object on the screen and allows you to stretch, rotate, and skew any object. If you want to increase or decrease the size of an object uniformly, then hold down the shift key as you pull one of its corner handles.

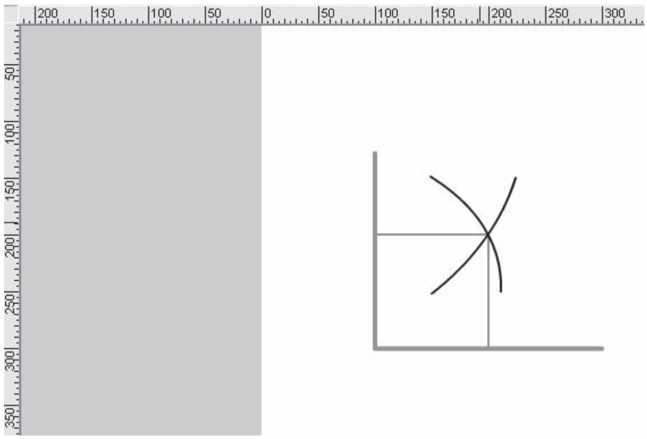
- *Place* your **cursor** on the bottom right side of the line you have just drawn; adjust the position of the cursor until it turns into a "curved" cursor.

Note: It may take some practice to position your cursor just right so it changes shape (and therefore its function).

- When this cursor appears, *click and drag* the **line** until it curves over the point (200X, 200Y), which is the intersection of the previously drawn green lines.

Draw Supply Curve

- *Create* a new **Layer** and *rename* it "Supply"
- *Draw* a **line** from (150X, 150Y) to (210X, 250Y) and *curve* it so it intersects with the point (200X, 200Y)



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Lock the Layer

- Select the Lock on the Layers Demand, Supply, GraphFrame, and Interface

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Note: By locking the Layers, you can prevent yourself from inadvertently moving objects on those layer. This is particularly important when you have meticulously placed the objects (as you have above).

Test the Application

Note: At this point, you can test out the application to determine whether it is functioning as expected.

- From the **Menu Bar** *select* **Control** and then choose **Test Movie**.

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Summary

You have observed how the Line tool functions. You can use the Line tool in any number of applications. The Line tool is particularly useful instructionally when you are pointing to attributes of concepts; it is a useful tool in drawing the learners' attention to relevant parts of the stage.

Dynamic Text

Dynamic text allows you to assign text to a variable and then it will appear in the Flash application any time the variable is used. Dynamic text is useful because it allows you to centralize the text. Titles, headings, and objectives should all change based on the context. If the text were placed on the screen statically, each screen would have to be reproduced individually any time you wanted to reuse an interface.

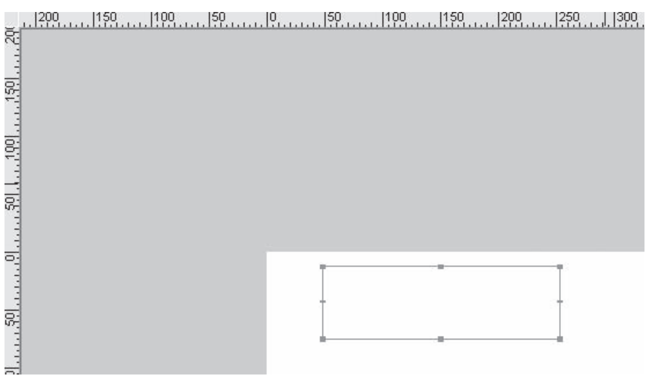
FLASH GUIDES FOR DYNAMIC TEXT

Label Interface Layer

- *Select* layer 1 and rename it "interface"

Create Dynamic Text Box

- *Select* the **Text** tool and *draw* a **Text box** on the stage (50X, 25Y) to (250X, 75Y) 



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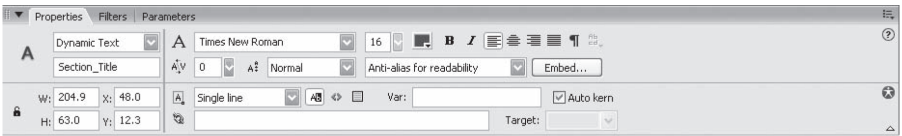
Note: The text box can be made any size. It will appear to be transparent on the learner's screen except for the text itself.

- In the Property Inspector *set* the **text type** to Dynamic Text, *set* the **font** to Arial, *set* the **font** size to 16, and the **color** to #0000FF, *Label* the Instance "Section_Title"

Note: The parameters in the Property Inspector describe what the text will look like on the screen.



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Note: By choosing Dynamic Text, you are telling Flash to put whatever text you assign to the variable "Section_Title" into this box. Since this interface may be reused, we want to be able simply rename the variable to change the text on the screen. This is much more efficient than deleting and re-creating text on the screen.

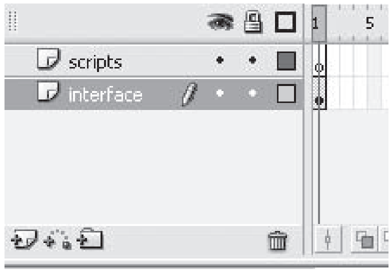
Note: There are three types of text in Flash. Static Text allows you to place text directly on the stage; Dynamic Text allows you to assign the text that will show up on the screen through a variable; and Input Text allows the learner to type in text and have it assigned to a variable for later use. In this case, use Dynamic Text because you want to separate the content from the interaction (you want to be able to go to one place to change all of the text). You will see that this is advantageous when you begin to revise your applications.

Note: To assign text to a variable, you must do some simple coding as follows.

Assign Text to a Variable

- Create new layer
  - From the **Menu Bar** *select* **Insert** then **Timeline**, finally **Layer**.
- *Rename* the **Layer** "Scripts"

Note: By creating a new Layer, you separate the elements so that they can be manipulated without affecting the other elements. It is good practice to separate elements whenever possible.



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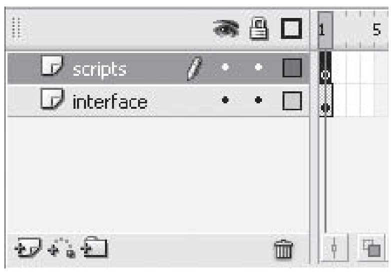
Note: Notice that the first frame of the "Interface" has a circle filled with black in it. A circle on a frame means that it is a keyframe. A black circle means that there is content on that frame. A keyframe is necessary any time there is a new object placed on the stage. The "Scripts" keyframe has a circle that is not filled. This indicates that no content has yet to be added to that frame.

Add an Action

- *Select* the **Keyframe** on the "Scripts" layer



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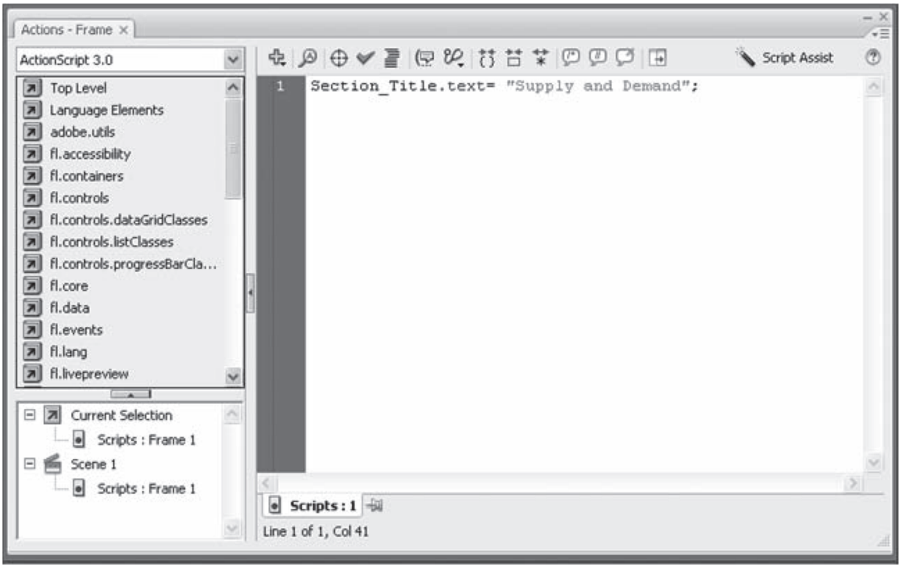
- From the **Menu Bar** *select* **Window** and then **Actions** (F9)
- *Type* "Section_Title" `"Supply and Demand";`

Note: The Courier New font is used to indicate ActionScript code.

Note: This code means that the variable Section_Title is assigned the text box "Supply and Demand."

Note: Be sure to type the code exactly as written; syntax is very important for Flash to operate properly.



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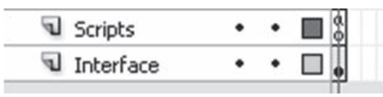
Note: Notice now on the "Script" Layer of the Timeline that there is now an alpha symbol. This means that there is now ActionScript associated with the frame.



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Note: Flash version CS3 requires you to place your code in a layer. In previous versions of Flash, ActionScript can be placed in other places as well; however, it is good programming practice to place it on a dedicated layer inside of a keyframe. This way you can find your code quickly.

Note: Once you have inserted the code, you can hide the Action panel by double clicking on its Title Bar.

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Note: All the panels in Flash version CS3 have this ability to be quickly hidden to free up screen space.

Test the Application

Note: At this point, you can test out the application to determine whether it is functioning as expected.

- From the **Menu Bar** *select* **Control** and then choose **Test Movie**.

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

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Summary

Since dynamic text is assigned to a variable, it can be presented to the learners conditionally. For example, suppose text is presented to the learners based on how many questions they have correctly answered. With dynamic text, you could easily suggest that they review part of the application or encourage them to move forward, depending on the need.

Symbols

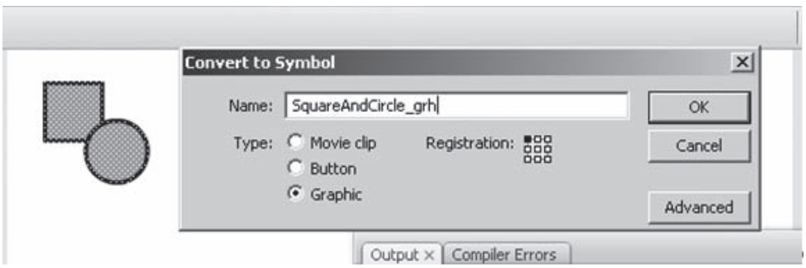
A symbol is an object that can be reused within Flash. Each instance of the symbol retains the basic characteristics of that symbol. There are three types of symbols: button, movie clip, and graphic. All symbols are placed in Flash's

"library," a repository for reusable objects. A graphic symbol is similar to the grouping feature in that it allows for any set of graphical elements to be joined together to as a single entity and reused.

FLASH GUIDE FOR SYMBOLS

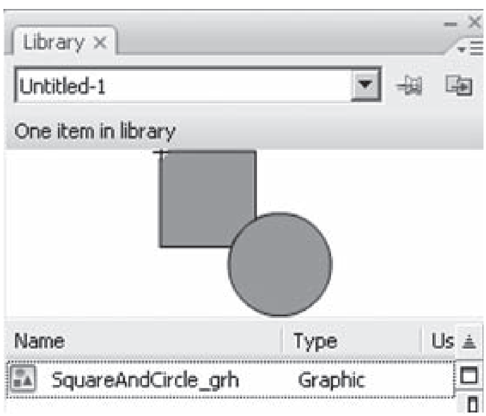
Create a Graphic Symbol

- Create or select a graphic or a set of graphics on the stage
- From the Menu Bar, select Modify and Convert to Symbol (F8)
- Label the Symbol and Select Graphic Symbol



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: The graphic symbol now appears in the Library.



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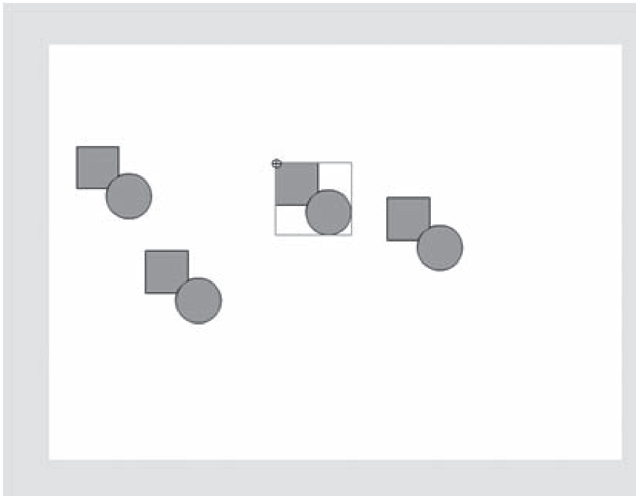
Note: The graphic symbol can be placed on the stage as many times as it is needed by dragging and dropping it onto the stage.



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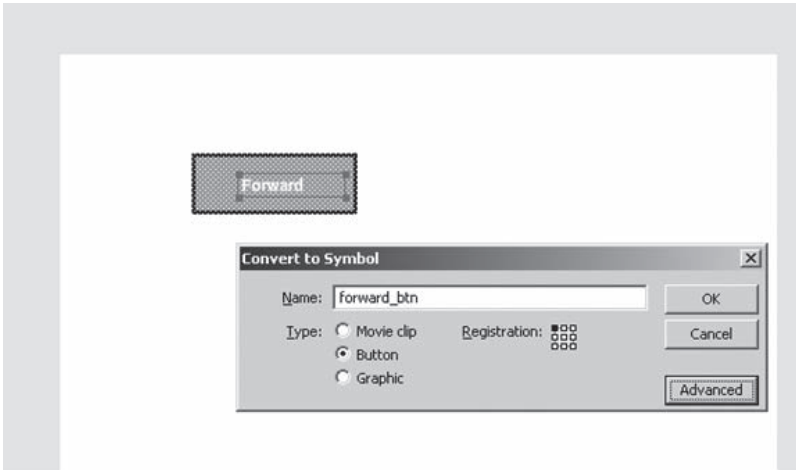
Note: Each time you drag the symbol to the stage, it creates a new instance.

Button Symbol

Note: A button symbol allows the user to interact with Flash. When a user "presses" a button, it triggers an event. Buttons can change how they look depending on what the user is doing.

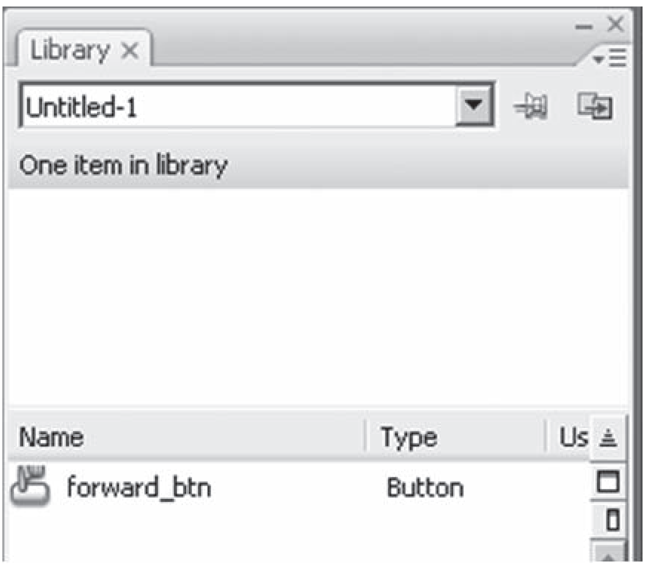
Create a Button Symbol

- Create or select a graphic or set of graphics on the stage
- From the Menu Bar, select Modify and Convert to Symbol (F8)
- Label the Symbol and select Button Symbol (it is convention to use a label such as "symbolname_btn")



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: The button symbol now appears in the Library.



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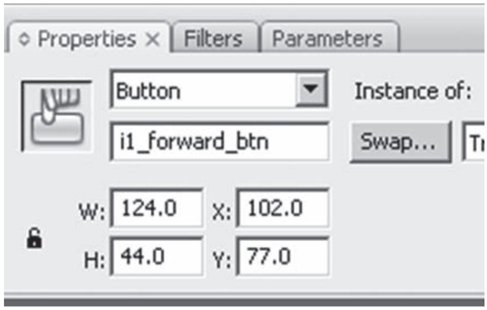
- Label the button instance “i1_forward_btn“



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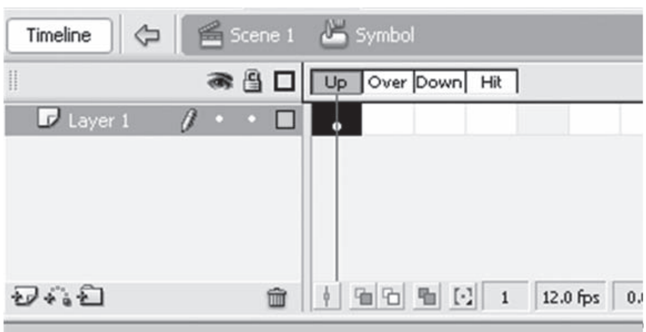
Note: A button has four states. Each state has a frame that can contain graphics, as demonstrated below:

- Up—What the button looks like as it appears on the screen
- Over—What the button looks like when the cursor is on top of it
- Down—What the button looks like when the user “clicks” the button
- Hit—An invisible area that defines what is clickable on the button. This is only required if the other frames are empty.

Note: To view these states, double click on the button.



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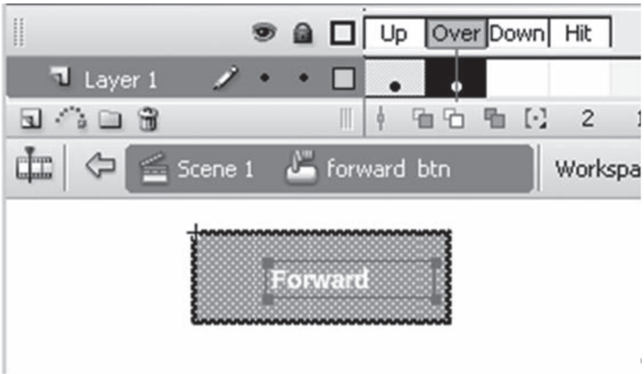
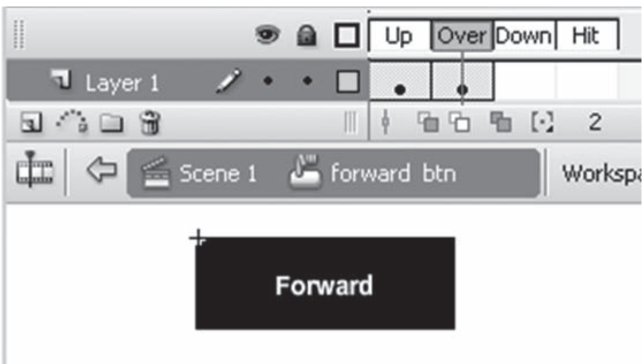
Modify a Button (Add an Over State)

- Open up the button's timeline by double clicking it on the timeline
- Select the Over frame on the button's timeline to edit its contents and add a Keyframe



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Select the gray graphic and double click it to change its color to black ()



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- Return to the timeline
- Select the icon "Scene 1"

Adding Instructions to the Graphic

Note: To make a button react to the user, you must program in some ActionScript code.

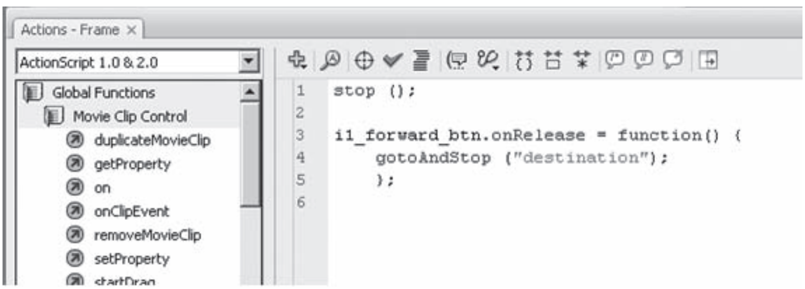
- Create a new layer

  - From the Menu Bar, select Insert, then Timeline, then Layer
- Label the new layer "Actions"

Note: All code should be placed in the layer Actions. Placing code in the Action layer makes it easy to find.

- View the Actions panel (F9)
  - From the Menu Bar, select Windows, then Actions
- Type code in the Actions Panel

```
i1_forward_btn.onRelease = function() {
   gotoAndStop ("destination");
   };
```



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: This code is written for ActionScript 2.0, so be sure to start with a file with ActionScript 2.0 selected. If you have begun with ActionScript 3.0 selected, be sure to save your document as Flash 8 and it will default to ActionScript 2.0.

Note: The code stop(); is simply there to stop the application from moving down the timeline.

Note: Although this text does not focus on ActionScript, the code can be interpreted as:

```
i1_forward_btn.onRelease
```

Note: Determine whether the i1_forward_btn button instance is receiving and activity from the user.

```
gotoAndStop ("destination");
```

Note: If the activity on i1_forward_btn is a release of the mouse over the button, then goto the Frame labeled "destination" and stop.

Note: The timeline now has an alpha symbol on the frame where code was added.

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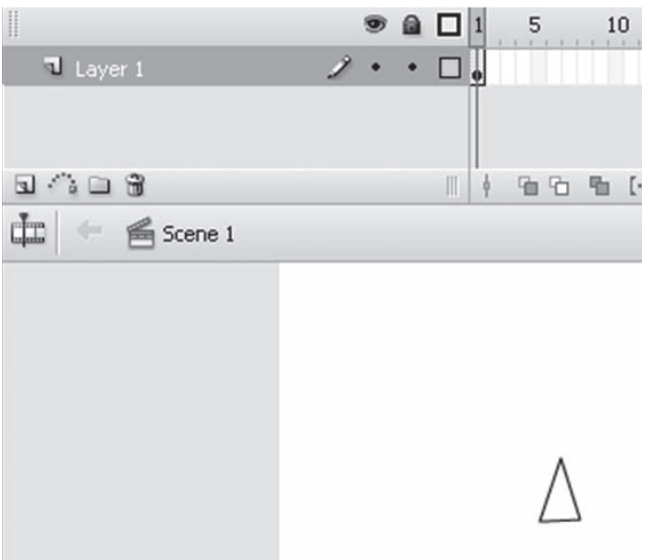
Movie Clip Symbol

Note: Movie clips are self-contained Flash animations. They can operate independently. For example, suppose you wanted to have a police car that you were going to animate moving across the screen and you wanted to lights to flash. The flashing of the lights must occur independently of the motion across the screen. The way this can be accomplished is through a movie clip.

- Create or select a graphic or a set of graphics on the stage



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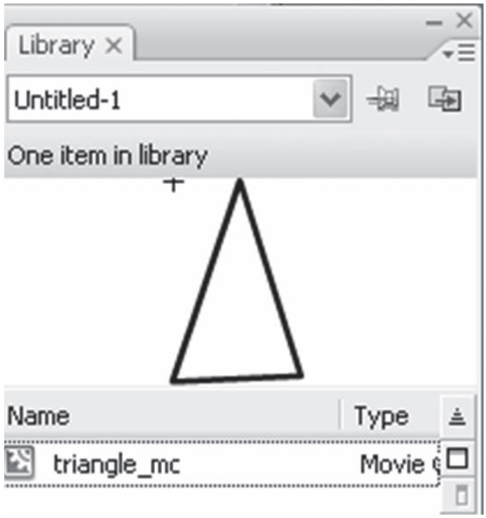
- From the Menu Bar, select Modify and Convert to Symbol (F8)
- Label the Symbol and Select Movie Clip Symbol

Note: The button symbol now appears in the Library.



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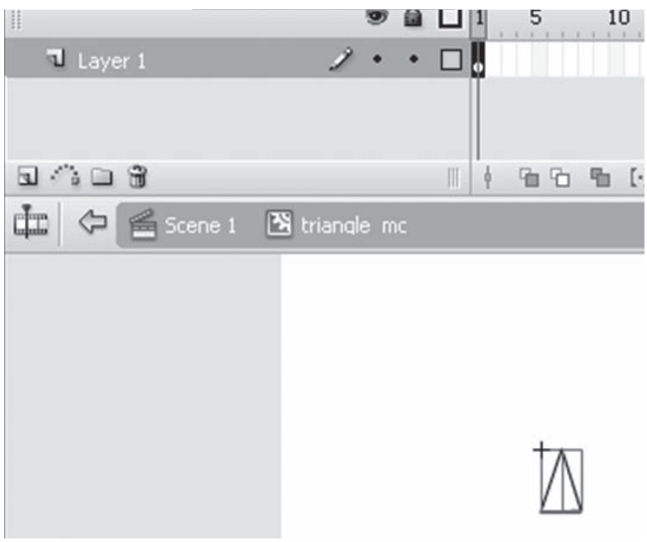
Edit the Movie Clip

- Select the movie clip instance on the stage and name it "i1_triangle_mc"
- Double click on the instance i1_triangle_mc

Note: Each movie clip has its own timeline.



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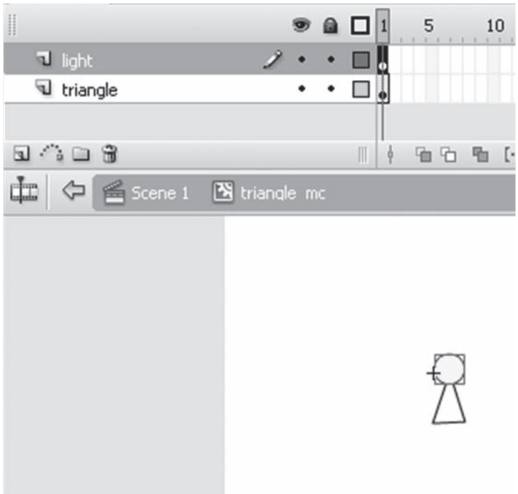
- Label the layer with the triangle "triangle"
- Add a layer and name it light
- Draw a small circle using the oval tool, select the color yellow (#FFFF00)



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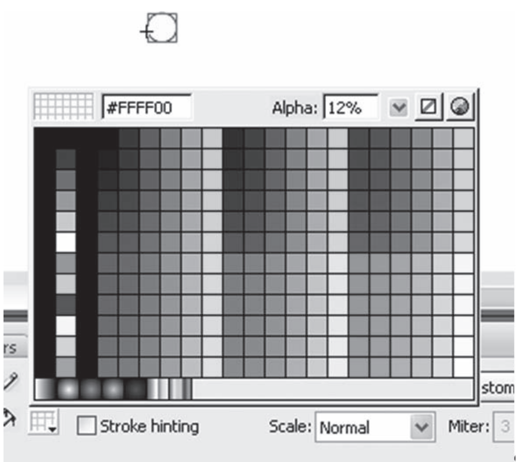
Create Light Animation

- Insert a keyframe on frame 10 of the light layer
- Select the yellow circle and change its alpha value in the Property Inspector



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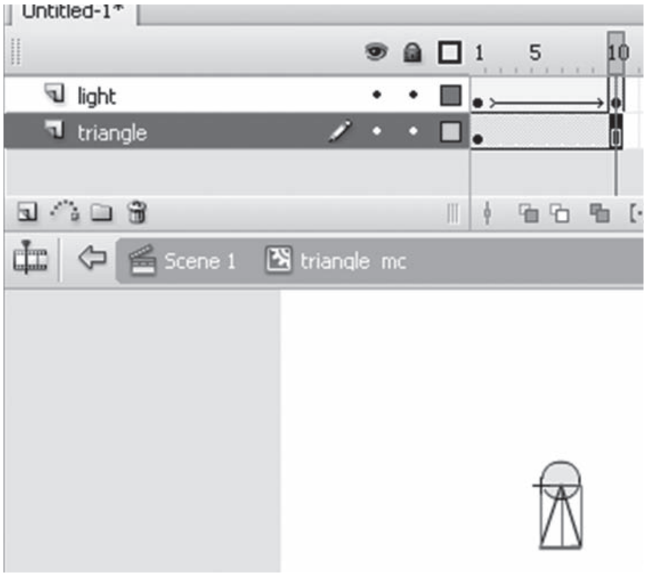
- Select the first frame of the light layer and insert a shape tween
- Insert a frame on frame 10 of the triangle layer



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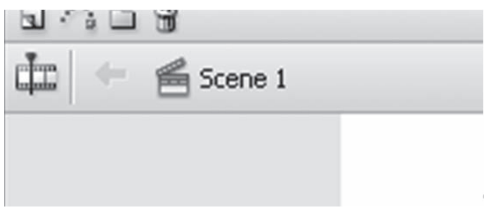
Populate the Stage with Instances

Note: Make sure you are on the main stage of Scene 1



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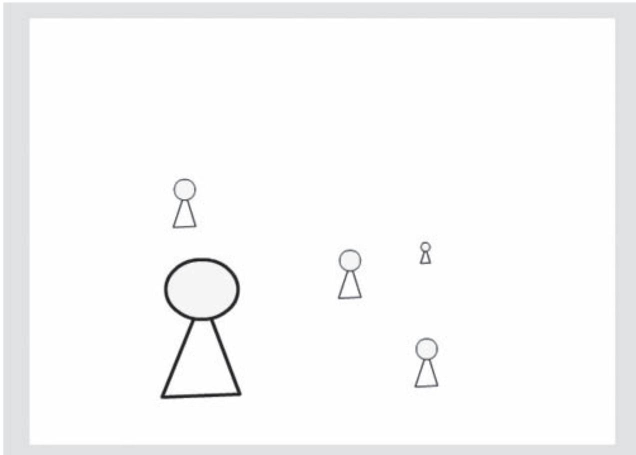
- Drag instances to the stage from the library
- Resize the instances with the transformation tool



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Summary

Symbols are one of the core technical ideas behind Flash. Symbols allow you to create content that is infinitely reusable. They also allow a level of independence; they allow segments of information and action to be modularized. This is a powerful ability, particularly when applied to instruction. Many of the instructional interventions will be reused. For example, the layout of the screen might be used from application to application. A layout might include graphics as well as dynamic text boxes. By turning those into symbols, they can easily be reused.

Separating Text

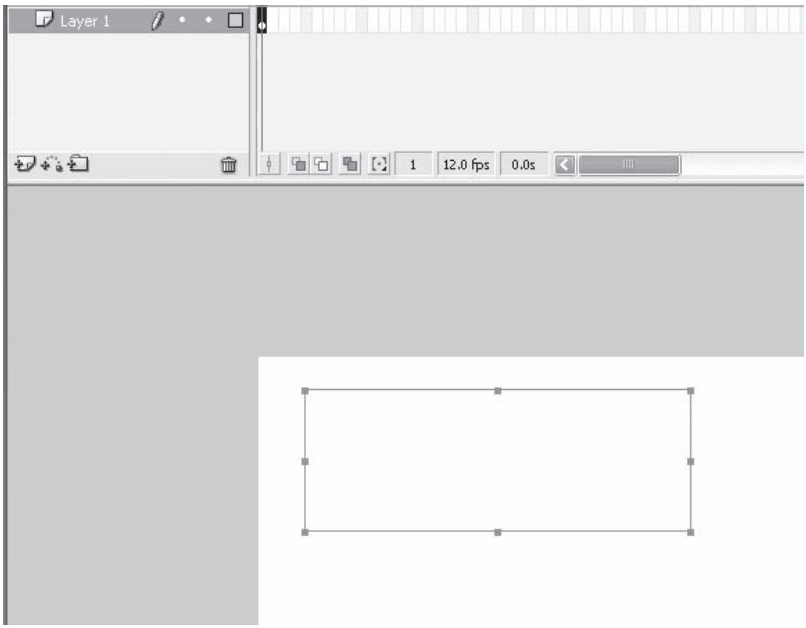
This technique allows you to easily break text into its individual letters.

FLASH GUIDE FOR SEPARATING TEXT

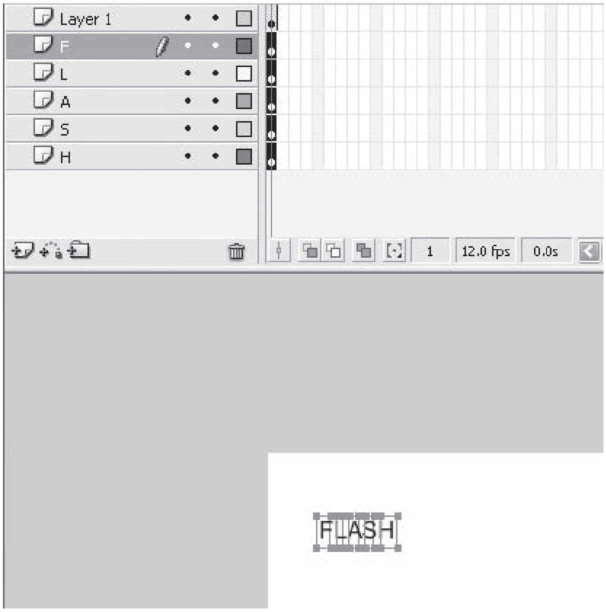
- Open a new Flash document
- Label the layer "Text Separate"

- Draw in a Text box using the Text tool
- Set the text type to Static

Note: Static text will show directly on the screen, while dynamic text needs to be assigned through ActionScript (see Dynamic Text)



- Type "Flash" in the text box
- From the Menu Bar, select Modify, then select Break Apart (Cntl+B)
- From the Menu Bar, select Modify, then select Timeline, then Select Distribute to Layers
- Reposition the letters on each layer



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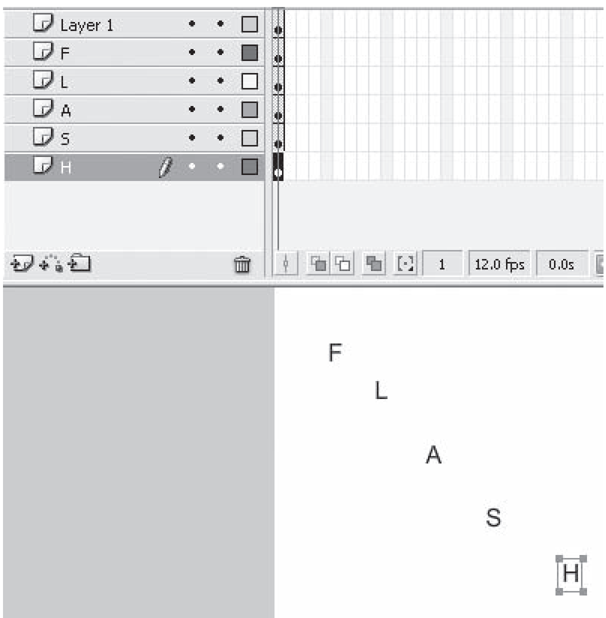
Note: Now each letter is on its own layer and can be manipulated independently.



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Test the Application

Note: At this point, you can test out the application to determine whether it is functioning as expected.

- From the **Menu Bar,** *select* **Control** and then choose **Test Movie**.

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

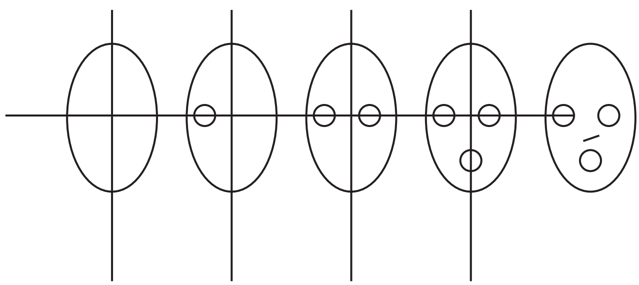
Summary

This technique lays the foundation for a number of instructional interventions. Once words can be broken up, they can be animated to help draw the learners' attention.

Frame-by-Frame Animation

Animation has traditionally been made by drawing an object on a translucent cell and then copying the object onto another cell while modifying it slightly. The accumulation of modifications would create the illusion of animation when cells are looked at in sequence. It was common practice for the best artists to focus their time drawing the main events in an animation, perhaps drawing only one out of ten cells. More inexperienced artists would then draw the in-between cells. Figure 7.1 demonstrates this method.

Figure 7.1. Images Slightly Modified.



Flash allows you to create animations through the same method. By placing images on successive frames of the time line, you can create the illusion of animation.

FLASH GUIDE FOR ANIMATION

Create a Frame-by-Frame Animation

Note: many of the actions in this guide have been introduced in previous guides and will only be briefly described below:

- *Create* a new Flash **file**
- *Rename* Layer 1 as "Ball"
    - *Select* Frame 1 of the Ball layer
- *Draw* a circle
- Select the Oval tool from the Tools panel 

Note: The Oval tool shares the palette with the Rectangle tool; if you do not see it, click on the Rectangle tool to switch tools.

- Position your cursor in the top left-hand side of the stage
- Hold down the shift key

Note: The shift key constrains the Oval so that it will make circles

- Drag the cursor to draw a small circle
- Select the Transformation tool and reselect the circle

Note: You should select both the inside of the circle and its edge (they are separate entities).

Note: You can resize an object on the screen by clicking and dragging one of the handles that appear on the object when you select it with the transformation tool.

- Resize the circle so that its Height is 44 pixels and its Width is 44 pixels

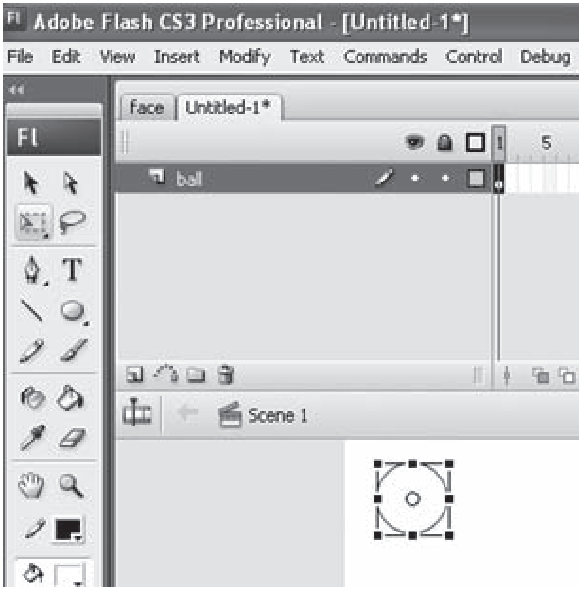
Note: You can tell how big the circle will be by viewing the Property Inspector Panel.

Note: Pixels are the individual points or dots that make up a computer screen; the more pixels per inch, the greater the resolution,

- Move the circle to the upper left-hand side of the stage

Note: You can move the object around the screen by selecting it from the inside and not on the handles.

Note: You can also rotate the object clockwise and counterclockwise by positioning your cursor just outside of the handles (the cursor will turn into a small circular arrow).



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Create and Modify the Circle

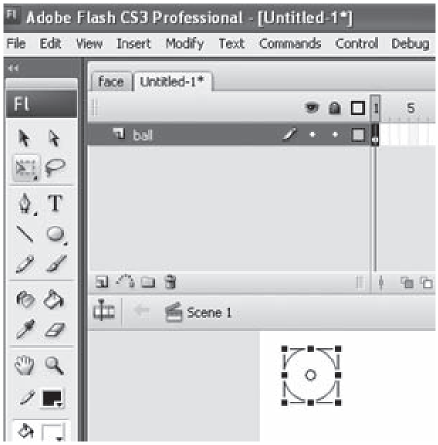
- Insert a new Keyframe
  - Position your cursor on Frame 2 of the layer Ball
  - From the MenuBar, select Insert, then Timeline, and finally Keyframe

Note: When you insert a Keyframe, the contents of the previous Keyframe are copied to the new Keyframe.

Move and Modify the Circle

- Select the circle on the stage with the Selection tool 
- Drag the circle downward on the stage about 40 pixels

Note: it may be easier to use the arrow keys to move the circle.



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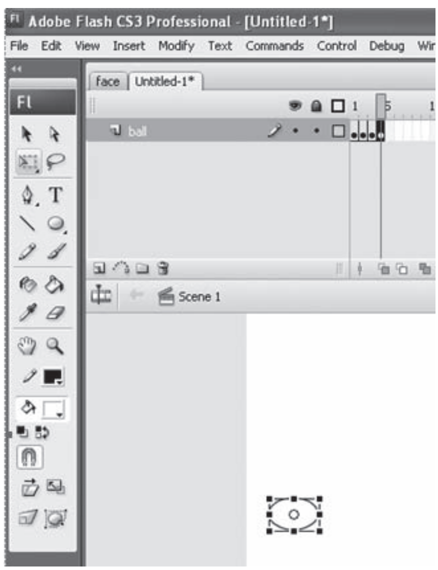
- Repeat the previous steps for two more Keyframes so you have four frames, each with a circle slightly lower than the previous one
- Create a "squish" effect
  - Create a new Keyframe on Frame 5
  - Drag the circle downward on the stage about 40 pixels
  - Modify the shape of the circle use the Transformation tool by pulling down on the top-middle handle



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- Repeat previous step on frame 6

Test the Frame-by-Frame Animation

- From the Menu Bar, select Control, then Test Movie (Ctrl+Enter)

Note: You should see the circle begin in the upper left-hand corner and gradually drop down the screen to the lower left-hand corner and change shape as it comes closer to the bottom

Summary

Frame-by-frame animation can be used any time that detailed animation needs to be used. The other animation techniques, Motion Tweening and Shape Tweening, allow the computer to decide how to interpolate between frames. These techniques are enormously powerful; however, they can be clumsy at times. You may find that to achieve the motion effect that you intended you will have to supplement a Tween with a frame-by-frame animation. Any instructional objective that require detailed visual changes should be done with the frame-by-frame animation technique.

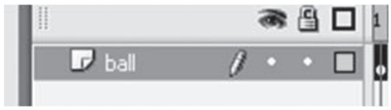
Shape Animation

The traditional method of manually creating each cell of an animation was digitized in through Flash's ability to create frame-by-frame animations. However, Flash has other, more powerful, methods of creating animation. Flash allows you to create graphics for individual Keyframes, and then it will interpolate or "fill in" any frames you leave in between, which creates a morphing effect. You can have one shape change into another over time that not only changes its location, but its color and size as well. This type of animation is called shape tweening and can be an enormous time-saver.

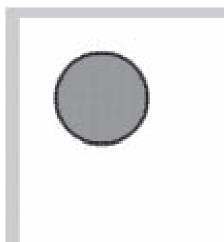
FLASH GUIDE FOR SHAPE ANIMATION

Create a Shape Tween

- Create a new Flash file
- Rename Layer 1 as "Ball"



- Select Frame 1 of the Ball layer
- Select the Oval Tool from the Tool Palette, and hold down the shift key as you draw a circle at the top left-hand side of the stage
    - Set the color of the circle to red (#FF0000)



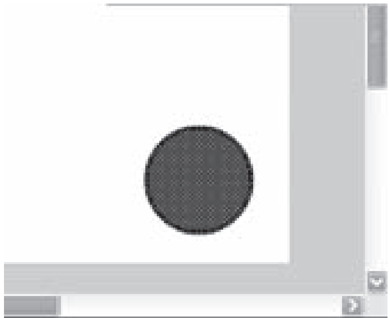
- Insert a Keyframe on Frame 10
- From the Menu Bar, select Insert, then Timeline, and finally Keyframe

Note: By inserting a Keyframe, you are duplicating the previous Keyframe onto Frame 10 and all of the frames in between.

- Using the Selection tool, drag the red circle to the lower right-hand side of the stage.

Note: Be sure to select both the stroke and fill of the circle (remember they are separate).

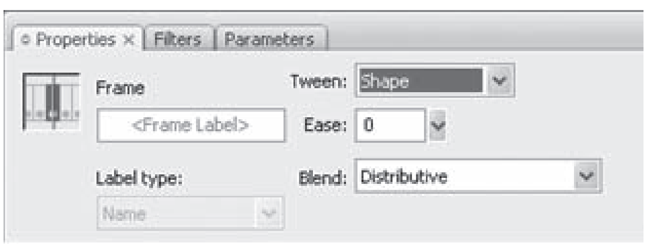
- In the Property Inspector Panel, set the color of the circle to blue (#0000FF)



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Reselect Frame 1 and select the Shape option from the Tween list in the Property Inspector

Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: The "Ease" is the degree of motion over time. A negative ease will begin slowly and end quickly, while a positive ease will begin quickly and end slowly.

Note: The "Blend" describes how a shape is blended. The angular option attempts to maintain sharp angles and line in the blending process, while the distributive option tends to smooth out sharp angle during a transition.

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- Test the movie (Ctrl-Enter)

Note: You should see the circle move from its starting point in the upper left-hand corner to the end point in the bottom right-hand corner and the circle's color gradually change from red to blue.

Note: The Shape Tween only works with vector-based shapes and images that have not been turned into symbols

Summary

Shape tweens allow you to create a blending effect; one element on the screen turns into another. This technique can be used to show the relationship between two elements. Shape tweening can be used to demonstrate the relationships between Concepts and to demonstrate the results of the application of a Principle.

Motion Animation

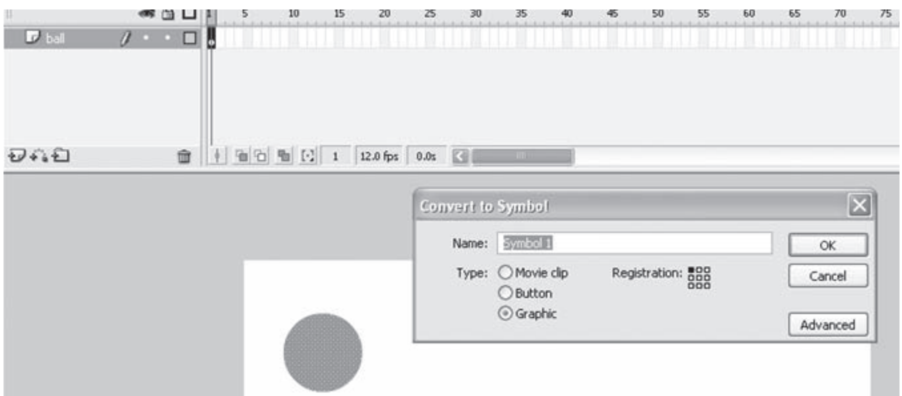
There are times when you want to animate something other than vector graphics. For example, you may want to animate a bitmap or a symbol. For example, if you had a movie clip symbol that was animating the flapping of a

bird's wings, it would appear stationary unless you moved that symbol across that stage with a motion animation.

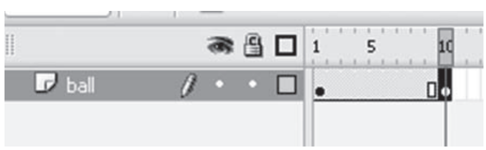
FLASH GUIDE FOR MOTION ANIMATION

Create a Motion Tween

- Create a new Flash file
- Rename Layer 1 as "Ball" [see Layers]
- Select Frame 1 of the Ball layer
- Draw a circle at the top left-hand side of the stage [see Drawing tools]
    - Set the color of the circle to red (#FF0000) [see Color]
- Select both the fill and the stroke of the circle [see Drawing tools]
- Convert the circle to a Graphic Symbol, name it RedCircle [see Symbols]

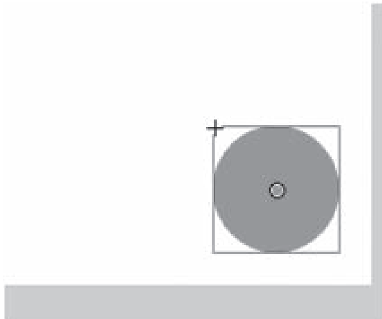


- Insert a Keyframe on Frame 10 [see Frame guide]



- Move the circle symbol to the lower right-hand side of the stage

Note: The graphic on frame 10 is a copy of the one on frame 1. Moving the graphic on frame 10 does not affect the graphics on frames 1 through 9.



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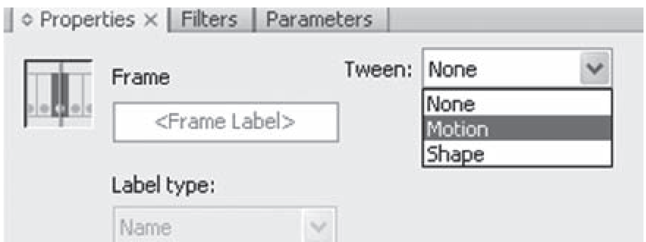
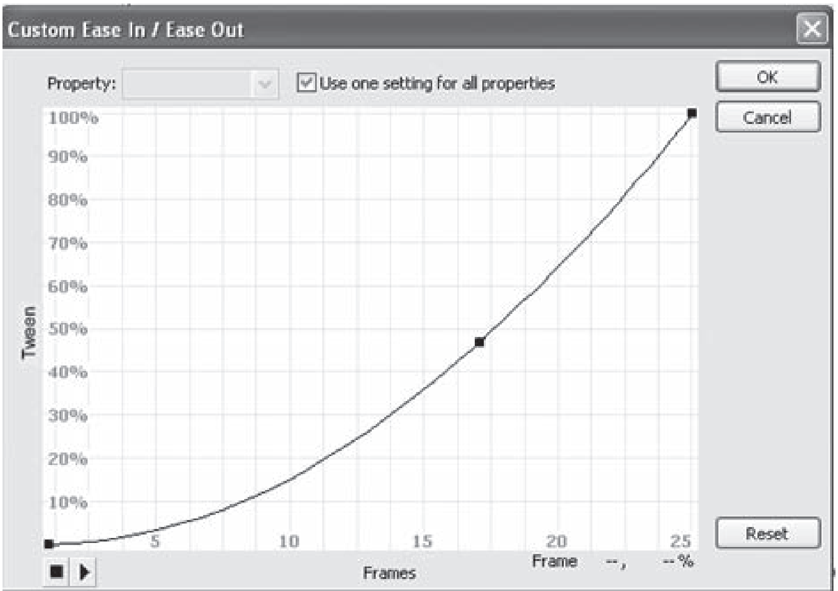
- Reselect Frame 1 and select the Motion option from the Tween list in the Property Inspector



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: The “Ease” is the degree of motion over time. A negative ease will begin slowly and end quickly, while a positive ease will begin quickly and end slowly. With a Motion Tween you can customize the ease by selecting and dragging any point on the Custom Ease graph.



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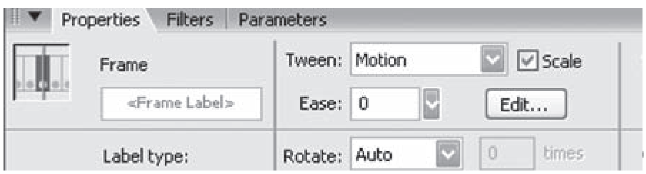
Note: The Rotate option allows you to control the Tween's direction (clockwise or counterclockwise).



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- Test the movie (Ctrl-Enter)

Note: You should see the symbol move from its starting point in the upper left-hand corner to the end point in the bottom right-hand corner.

Note: The Motion Tween only works with symbols and raster-based images.

Summary

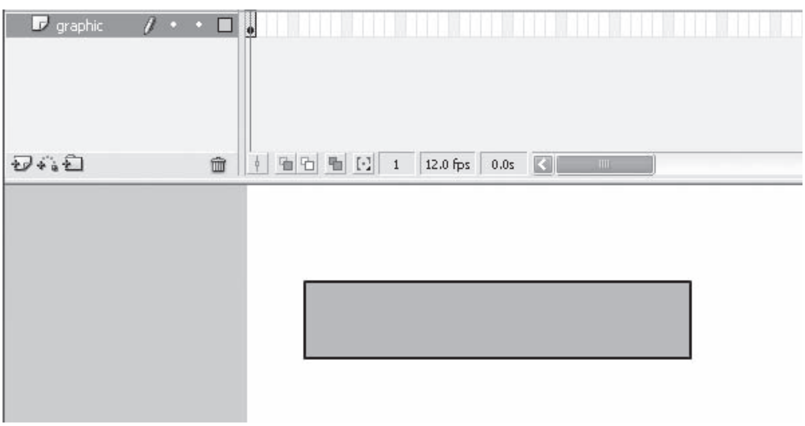
The motion tween allows you to move symbols on the stage. Movement is an important instructional tool, particularly for demonstrations. Instead of describing how something works, you can actually show it to the learners. The motion tween is particularly useful when using movie clips. For example, a movie clip could have an image of person's legs moving. By creating a motion tween with that movie clip, the illusion of a person walking across the stage would be created.

Masks

Masks allow you to cover or hide parts of the screen. The effect makes it easy for you to guide the learners' attention because it only reveals a portion of the images underneath it at any one time. The mask effect can be used in conjunction with tweening animation to move, expand, and contract the covered area.

FLASH GUIDE FOR MASKS

- Insert graphic
- Label the layer "graphic"
- Select the Rectangle tool and draw an object on stage



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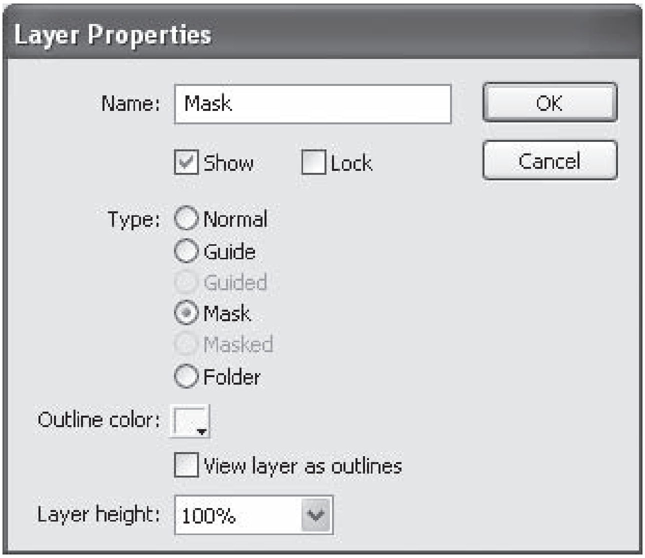
Add a Mask Layer

- From the Menu Bar, select Insert, then select Timeline, and finally layer
- Label the layer "Mask"
    - From the Menu Bar, select Modify, then select Layer, then select Layer Properties, and finally select the Type Mask



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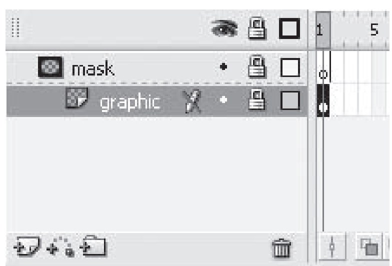
- Drag the graphic layer underneath the Mask layer

Note: The graphic layer should be indented under the Mask layer.



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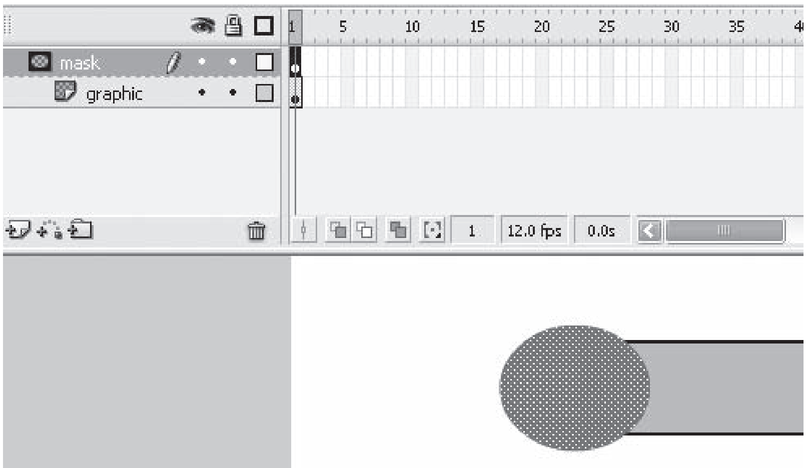
Add Mask Image

- Select the Keyframe on the Mask layer
- Draw an object on the stage
    - Use the oval tool to draw a circle. Be sure to change its color so it contrasts with your previously drawn rectangle

Note: You are drawing in the "mask." The mask will be the reverse of the object on the screen.



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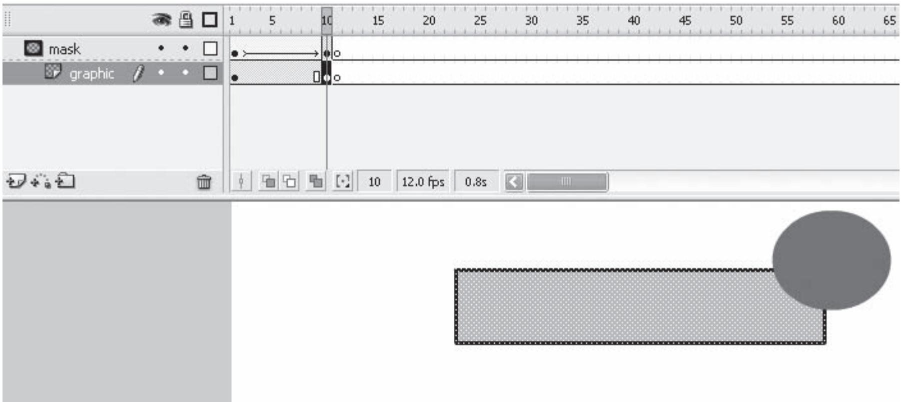
Animate the Mask

- Create a shape tween on the Mask layer through Frame 10 (See Shape Tween)
- Add a frame on the graphic layer at Frame 10

Note: Adding a frame on the graphic layer places the rectangle on each frame between 1 and 10. A Keyframe is not required because no new content is being added to this layer.

Note: By animating the mask, you are controlling, over time, what the learners will be able to see on the screen. From a technical point of view, this makes it easy use a single graphic to represent your content (instead of breaking up that graphic for use on multiple screens).



Test the Application

Note: At this point, you can test the application to determine whether it is functioning as expected.

- From the **Menu Bar** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Summary

The mask effect is a tool for controlling the learners' attention on a screen. You can use a number of mask effects on the same screen to improve the process further. In particular, masks are useful for relating parts to a whole. For example, in an anatomy lesson you could begin by showing a wide image of the entire body and then use a mask to focus the learners' attention, sequentially, on particular organs.

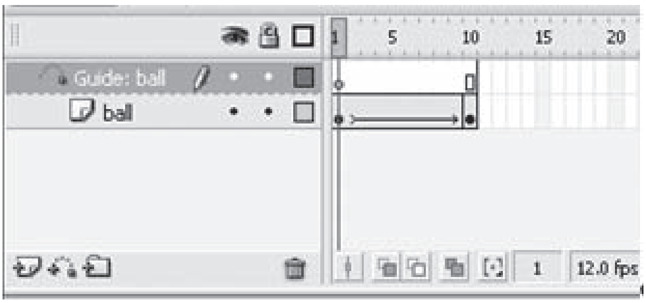
Motion Guide

Both Shape Tweens and Motion Tweens will animate along a straight line between two Keyframes. There are often situations in which it would be useful to have the animation follow a particular path. To create a path, you will have to use a motion guide. The following instructions should be followed after creating a Shape or Motion Tween.

FLASH GUIDE FOR MOTION GUIDES

Create a Motion Guide

- Create a new Flash file
- Create a Motion or Shape Tween [see Shape Tween, See Motion Tween]
- Select the Layer with the Tween
- From the Menu Bar, select Insert, then Timeline, and finally Motion Guide
- Insert a frame on Frame 10



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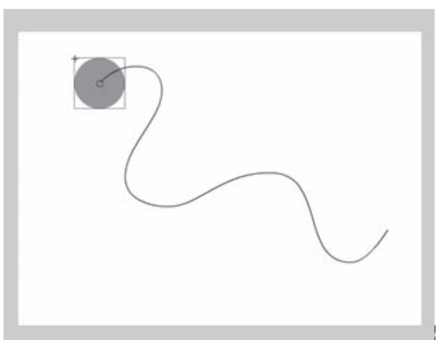
Note: Notice layer with the Tween is now indented beneath the Motion Guide

- Select the first frame of the Motion Guide layer
- Select the pencil tool and draw a path on the stage [see Drawing tools]
- Use the selection tool to click and drag the symbol on Frame 1 until it "connects" with the path



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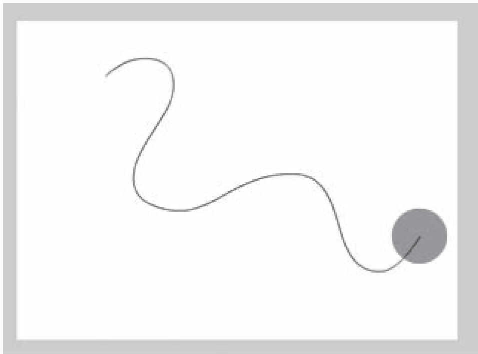
- Select Frame 10 of your Tween and click and drag the symbol until it "connects" with the path



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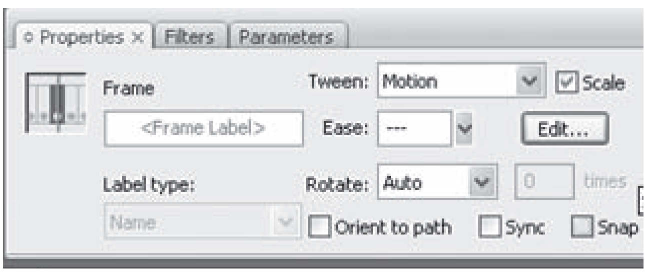
Note: The Guided Path option to "Orient to path" allows you to point your symbol in the direction of the path. The "Sync" allows you to synchronize with the main timeline if you are working within a movieclip. The "Snap" option attaches the object by its registration point.



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Test the Application

Note: At this point, you can test the application to determine whether it is functioning as expected.

- From the **Menu Bar** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Note: You should see the symbol move along the path.

Summary

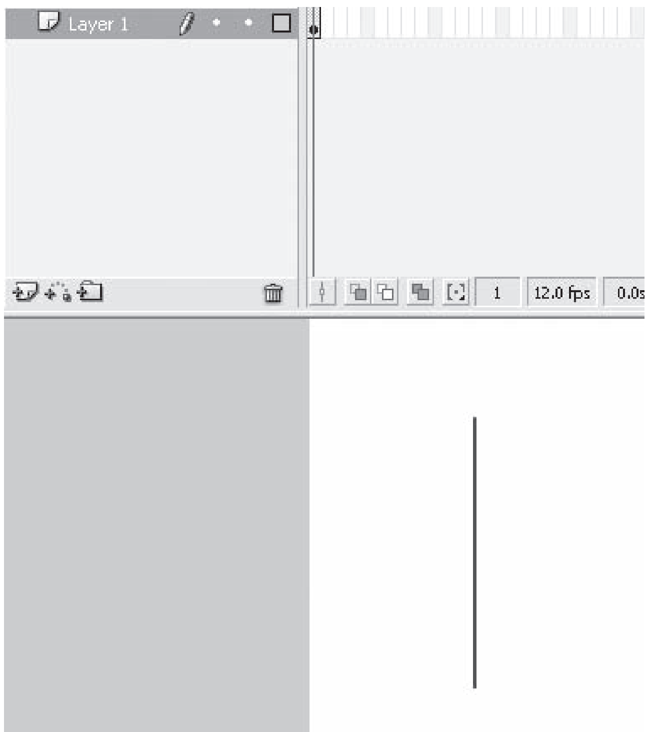
A motion guide is used to control where an animation will go on a screen. The motion guide allows you to choreograph a number of animations so that they support one another.

Simulated Screen Draw

This technique uses the timeline and shape tweens to create an effect of a drawing emerging from the screen

FLASH GUIDE FOR SCREEN DRAW

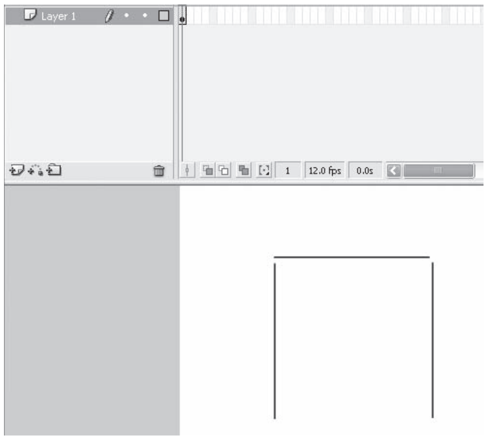
- Open a new Flash document.
- On Frame 1 of Layer 1 draw a single line using the line tool



- *Select* the line with the Selection tool
- From the Menu Bar, select Edit, then Copy, and finally paste
- Redo this procedure three times

Note: The pasted lines will be stacked on top of each other.

- Drag the line to create a box shape, being careful not to allow the lines to intersect. Use the Transformation tool to rotate the vertical sides to the horizontal.



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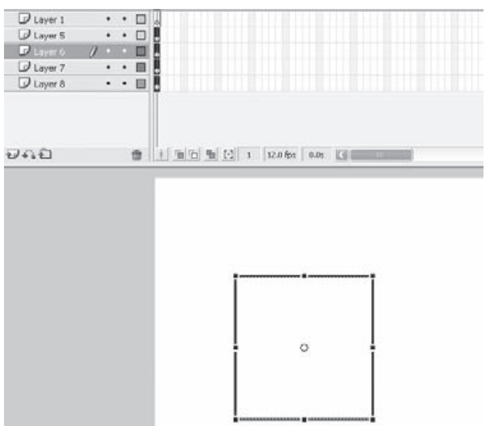
Distribute to Layers

- Select all of the lines on the stage
- From the Menu Bar, select Modify, then Timeline, and finally Distribute to Layers



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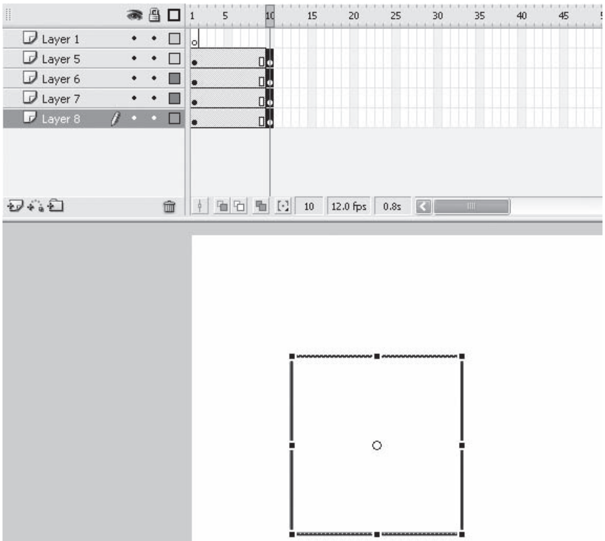
- Select Frame 10 for all of the layers and insert a keyframe (from the Menu Bar, Select, Insert, then Timeline, and finally Keyframe)



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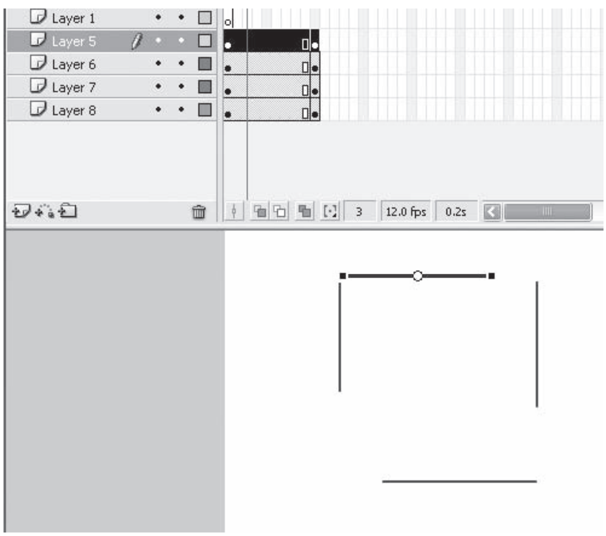
- Modify each line on Frame 1 of each layer



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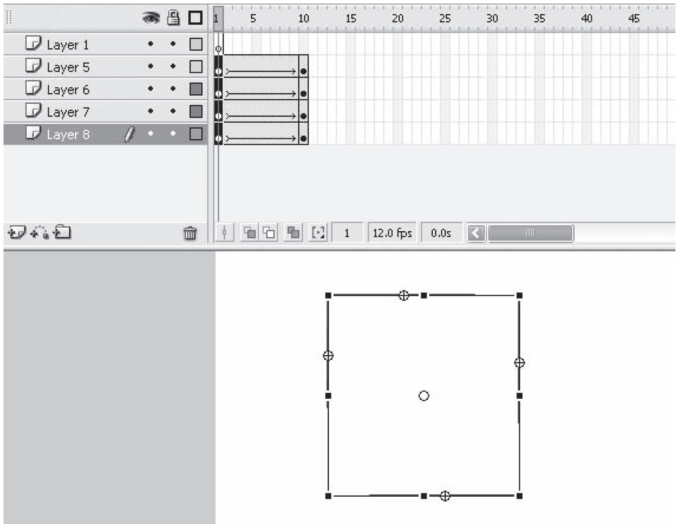
- Create a shape tween on all layers between the Keyframes on Frame 1 and Frame 10



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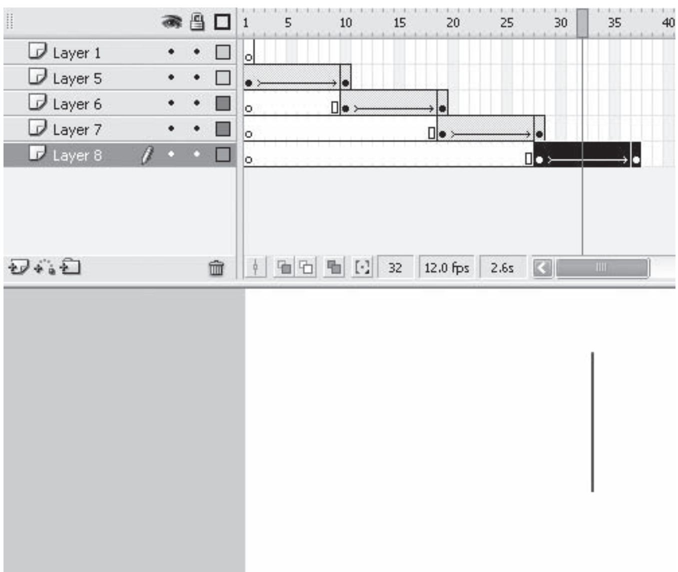
- Select the Frames on each layer and drag them across the Timeline in a stagger pattern



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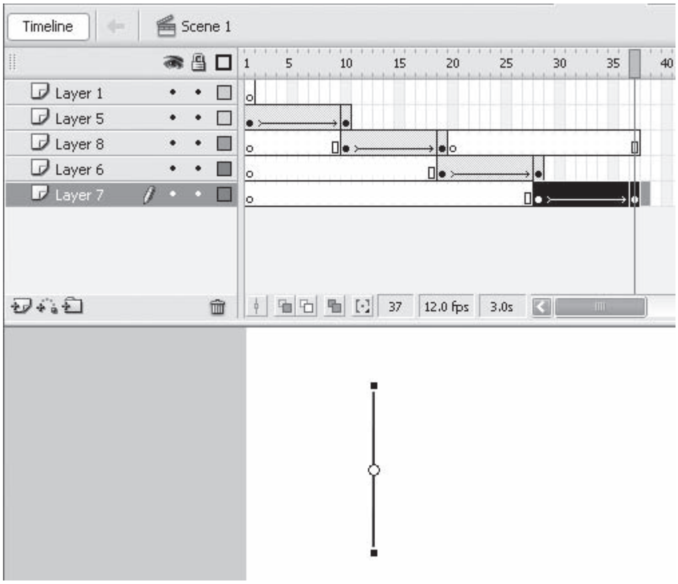
- Fill in Frames by Selecting Frames that parallel the last layer as follows



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- From the Menu Bar, select Insert, then Timeline, and finally Frames

Note: When the scene is tested, a simulated drawing effect will be observed.

Summary

This drawing technique is particularly helpful when teaching procedures because it allows you to demonstrate how a process emerges over time. This demonstration illustrated a simple procedure for drawing a box; however, the technique can easily be applied to complicated phenomena. An additional modification to the technique would be to insert a control button to allow the learners to step through the demonstration at their own pace.

Sound

Sound opens up another dimension to your Flash application. Studies have found that sound can reinforce the content presented on the screen.

FLASH GUIDE FOR SOUND

Adding Sound

- Create new Flash file
- Rename Layer 1 "Sound"
- From the Menu Bar, select File, then select Import, then select Import to Library, select speech.wav file

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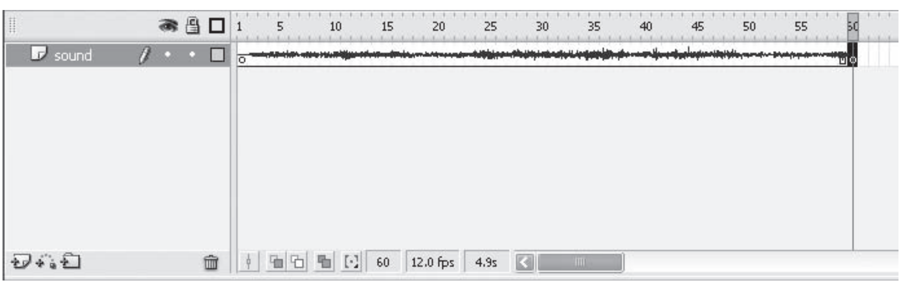
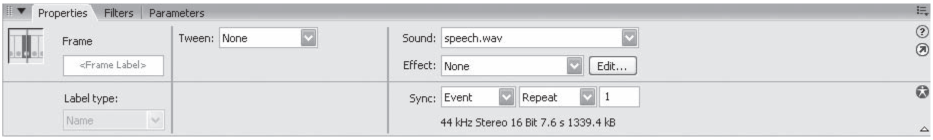
- Select Frame 1 of the Sounds layer, then drag the speech sound from the library to the stage

Note: This clip lasts close to five seconds when played. Extra frames will have to be inserted into the timeline for it to be heard in its entirety.

- Insert a Frame on Frame 60



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.



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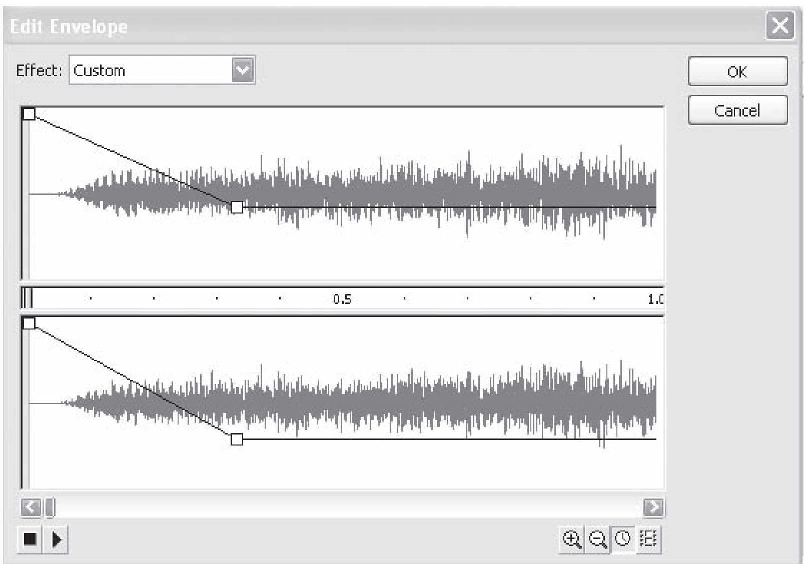
- Edit the Sound in the Property Inspector by selecting the Effect Edit button
- Select the point on the fade line to adjust the sound



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Summary

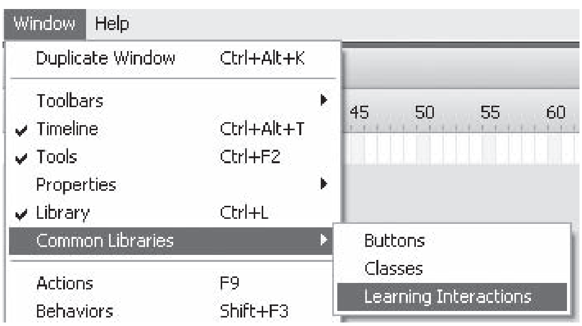
Sound can be used to provide feedback to the learners on their actions. For example, when a learner clicks on a button, by hearing a sound, a learner can confirm that he or she clicked on the appropriate place. Additionally, any time you are demonstrating process on the screen, narration can be used to allow the learners to focus on the screen instead of splitting their attention between the demonstration and text.

Learning Component: Drag and Drop

Flash has a set of learning components that are ideal for creating practice sequences and for assessing the learners. These components are pre-packaged tools that can be placed within any Flash application. With learning components, you no longer have to create interactions from scratch. The Drag and Drop component allows you to easily create interactions with the learners that allows them to perform by selecting an object on the screen and positioning it appropriately.

FLASH GUIDE FOR DRAG AND DROP

- Create a new Flash file
- Rename Layer 1 "Learning Interaction"
- Open the Learning Interactions library
    - From the Menu Bar, select Window, then Common Libraries, then Learning Interaction
- Drag the Drag and Drop Learning Interaction onto the Stage



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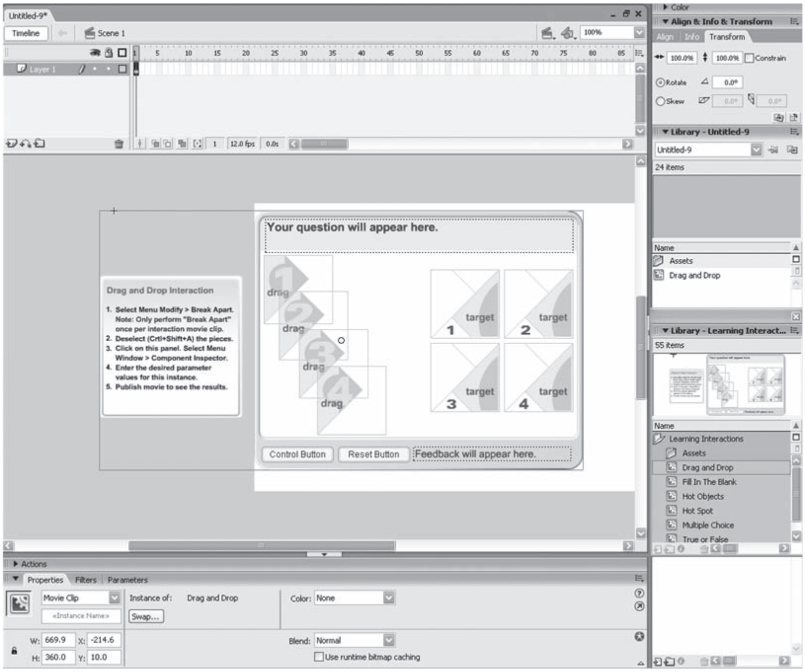
- Position the Learning Interaction so that the Instruction box on the left hangs outside of the stage area

Note: Never delete the Instruction box; it has important information for the learning interaction to operate properly. The instruction box will not be visible when the application is run.



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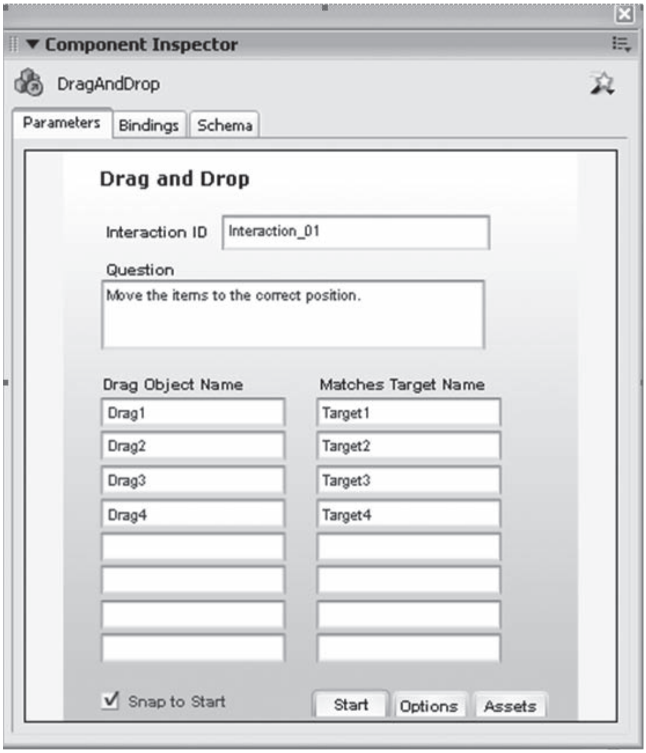
Break Apart the Interaction

- From the Menu Bar, select Modify, then Break Apart (Ctrl+B)

Note: The learning component is a set of tools that have been compiled together; by breaking it apart you can tailor its parts to your particular application.

- Deselect all of the components
    - From the Menu Bar, select Edit, then Deselect All (Ctrl+Shift+A)
- Select the Instruction box
- View the Component Inspector
    - From the Menu Bar, select Window, then Component Inspector (Shift+F7)

- Drag the lower right pull corner of the Component Inspector to enlarge
- Enter parameter values into Component Inspector



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Note: The Interaction ID is a code for used when integrating Flash content into a learning management system such as Blackboard, WebCT, or Moodle. Learning management systems are beyond the scope of this text.

Note: Question form: This is where you ask the learners to perform a task. The default is "Move the items to the correct position."

Note: The Drag Object Name forms describe the objects that are dragged. It is a good idea to name these objects something descriptive, while retaining the task and number. For example, Drag1, Drag2, Drag3, and Drag4 might be changed to RobinDrag1, ParrotDrag2, SeagullDrag3, and FinchDrag4. Likewise, the Matches Target Name forms could be changed to RobinTarget1, ParrotTarget2, SeagullTarget3, and FinchTarget4.

Note: To add another draggable object, simply type it into the forms. For example, SparrowDrag5 and SparrowTarget5.

Set the Feedback Options

- Select the Options tab in the lower right-hand side of the Component Inspector.

Note: If you want to give the learners feedback, check the Feedback checkbox.

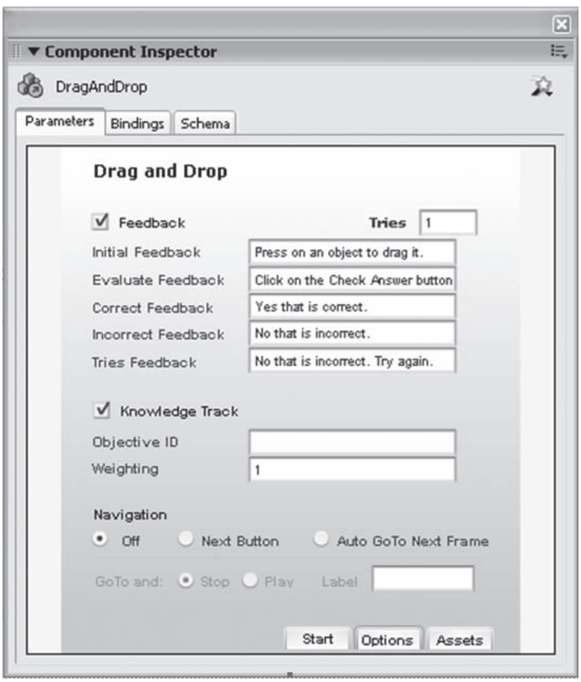
Note: The Initial Feedback form reports instructions to the user. The default is "Press on an object to drag it."

Note: The Evaluate Feedback form reports instructions on how to check their responses. The default is "Click on the Check Answer button."

Note: The Correct Feedback form is the report the learner receives if his or her response was correct. The default is, "Yes that is correct."

Note: The Incorrect Feedback form is the report the learner receives if his or her response was incorrect. The default is, "No that is incorrect."

Note: The Tries Feedback form is the report the learner receives if his or her response is incorrect and he or she is allowed to try again (you can set the number of tries in the tries form). The default is, "No that is incorrect."



Note: Knowledge Track is a set of settings if this component is used in a learning management system.

- Set Navigation to off

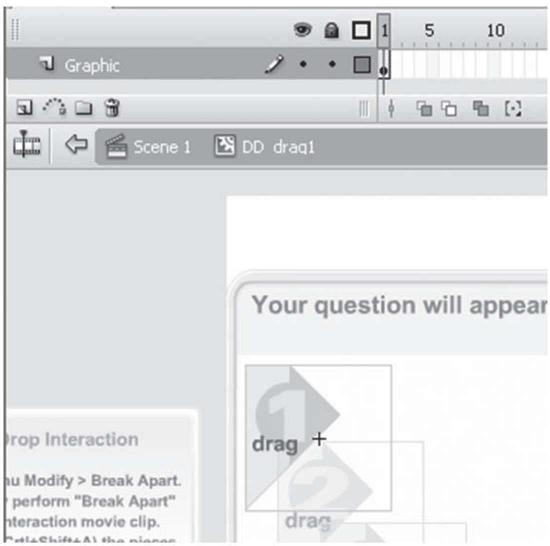
Note: Navigation can either be turned off or you can create Next Button that allows you to goto a specific frame on the Flash timeline (that frame must be labeled). You can also choose Auto GoTo Next Frame, which automatically moves the learner to the next frame.

Note: Assets, Bindings, and Scheme are features that can be used with a learning management system.

- Hide the Component Inspector by clicking on its bar

Replace the Placeholder Image

- Select and double click on the Drag1 symbol on the stage



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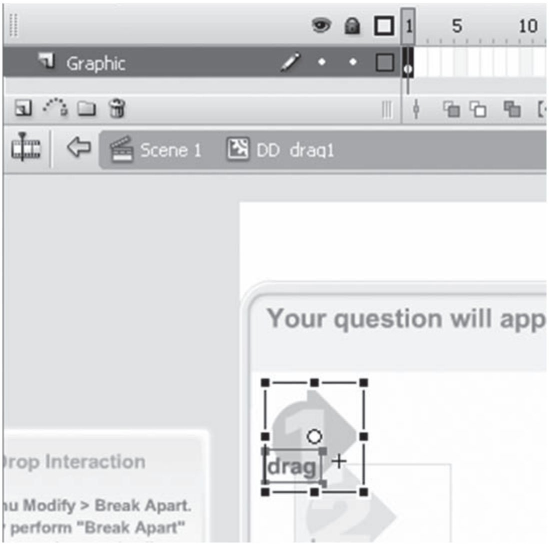
Note: Notice beneath the Timeline that there is the DD Drag1 symbol icon; this tells you that you are working with the symbol Timeline and not the Scene 1 Timeline.

- Select all of the placeholder graphics by selecting the Keyframe on frame 1 of the graphics layer, then hitting the delete key



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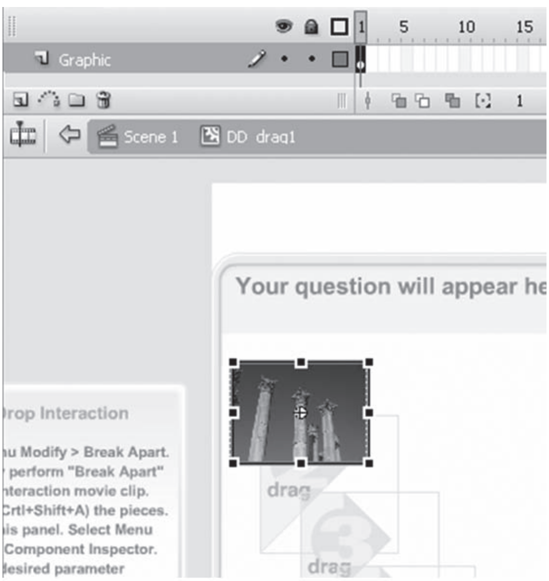
- You can now import a graphic to act as the object
  - From the Menu Bar, select File, then Import, then Import to Stage; select an image, then select Open



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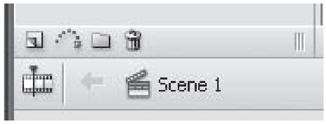
- Click on Scene 1 to go back to the main time line



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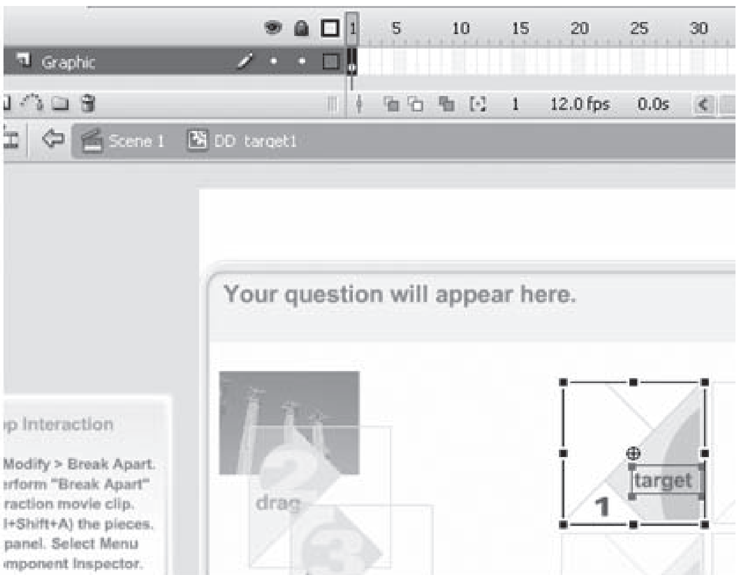
- Repeat replacing the placeholder graphics for all of the drag objects

- Replace the Target with a word
  - Select and double click on the Target1 symbol on the stage
  - Select all of the placeholder graphics by selecting the Keyframe on frame 1 of the graphics layer, then hitting the delete key



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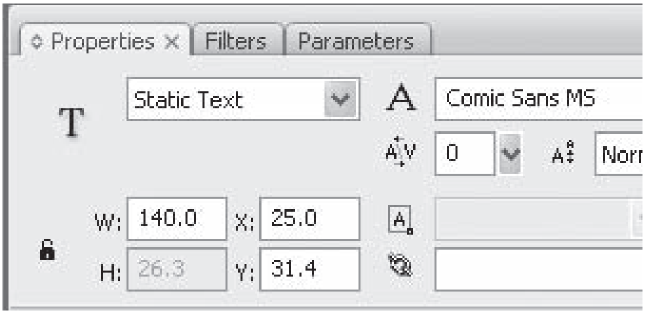
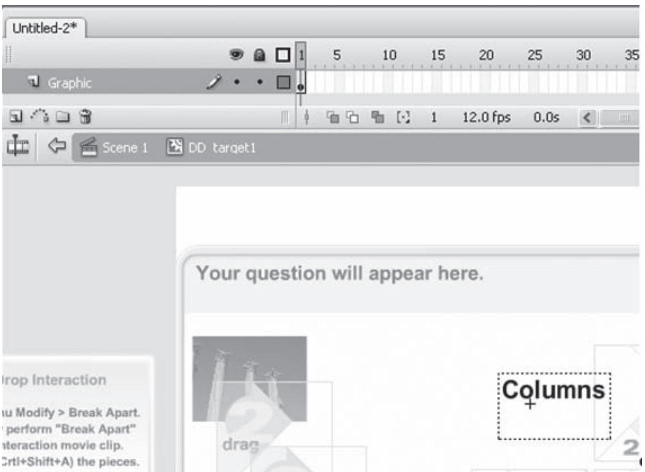
- Select the Text tool and position it above the position cross
- Draw in a text box
- Type in the word "Columns"
- Change the Text type to Static Text

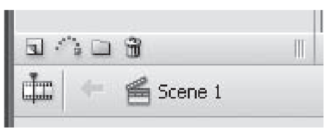


Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Click on Scene 1 to go back to the main time line



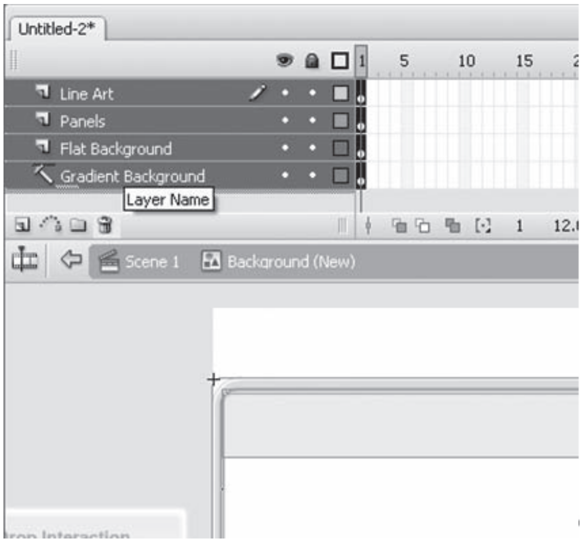
Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Repeat replacing the placeholder graphics with words for all of the target objects

Change the Background Placeholder Graphics

Note: The background graphic can be deleted or modified to make the learning component visually compatible with the rest of the application while retaining its functionality.

- On the Scene 1 Timeline, double click on the Background graphic with the Selection tool
- Unlock the locked layers
- Drag each layer to the trash can to remove the graphics



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Test the Application

Note: At this point, you can test out the application to determine whether it is functioning as expected.

- From the **Menu Bar,** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see

Summary

The Drag and Drop learning interaction is ideal for activities that require repositioning. For example, a module on anatomy might benefit from the

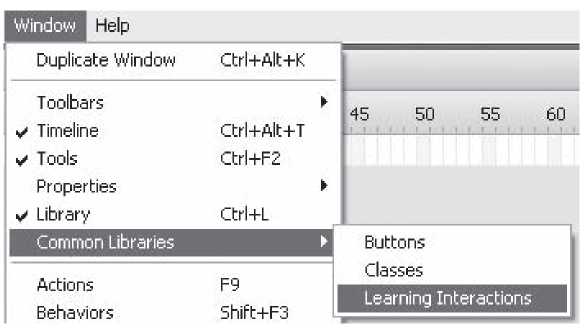
learners being able to select a particular bone and place it in the correct position relative to other bones, to indicate an understanding of structure. The Drag and Drop learning interaction template consist of a series of rectangles; however, you should be aware that the graphics that you will use to replace the rectangles can be of any shape or size. This allows you to use the learning component in a number of widely divergent situations. The Drag and Drop learning interaction is useful for both practice and assessment.

Learning Component: Fill in the Blank

Flash has a set of pre-built learning components that allow you to construct interactions that allow you to test the learners. These components are essential online learning tools. You will be familiar with many of these interaction types. The Fill in the Blank tool allows the learners to type in a response to a question. If a learner has made an acceptable response, he or she can receive supportive feedback.

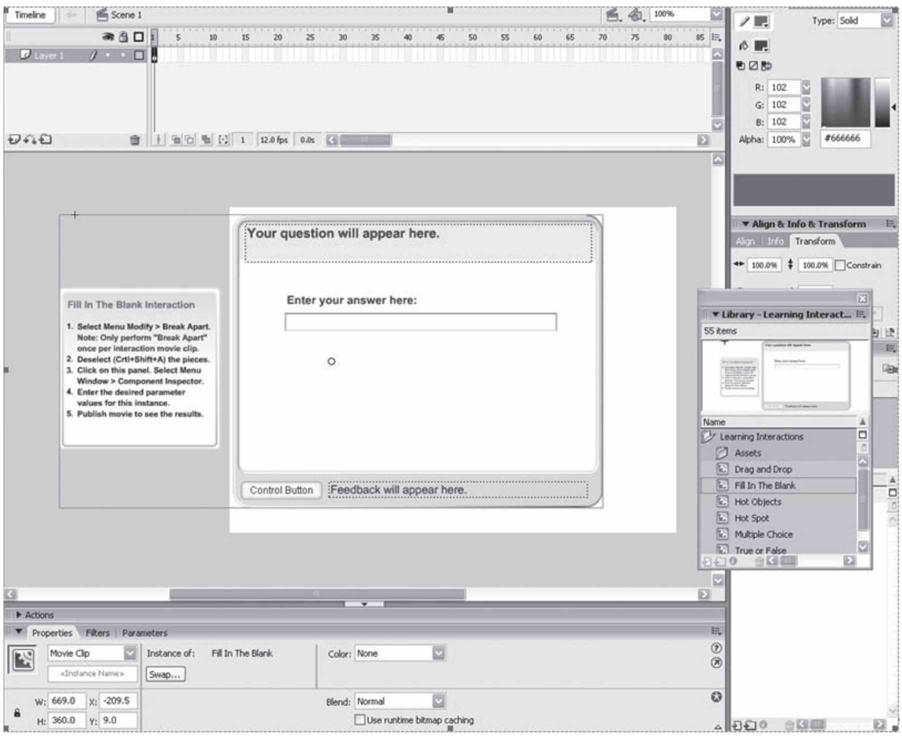
FLASH GUIDE FOR FILL IN THE BLANK

- Rename Layer 1 "Learning Interaction"
- Open the Learning Interactions library
  - From the Menu Bar, select Window, then Common Libraries, then Learning Interaction



- Drag the Fill in the Blank Learning Interaction onto the Stage
- Position the Learning Interaction so that the Instruction box on the left hangs outside of the stage area

Note: Never delete the Instruction box, as it has important information for the learning interaction to operate properly. The Instruction box will not be visible when the application is run.



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Break Apart the Interaction

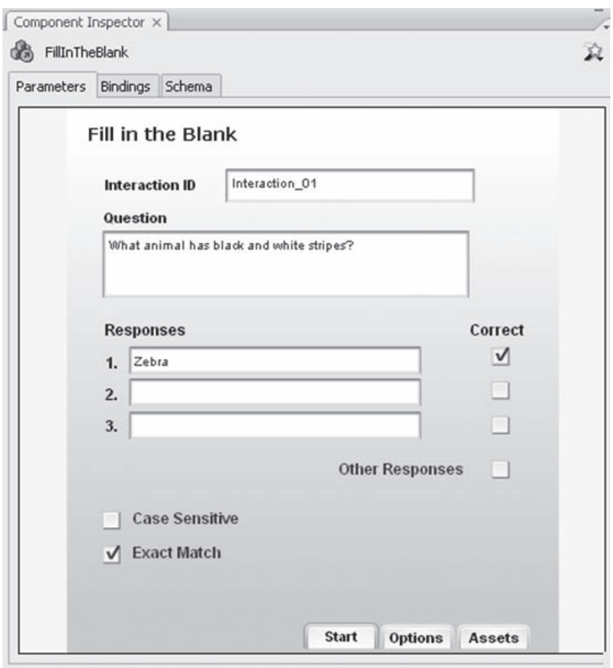
- From the Menu Bar, select Modify, then Break Apart (Ctrl+B)
- Deselect all of the components
    - From the Menu Bar, select Edit, then Deselect All (Ctrl+Shift+A)
- Select the Instruction box

- View the Component Inspector
    - From the Menu Bar, select Window, then Component Inspector (Shift+F7)
    - Drag the lower-right pull corner of the Component Inspector to enlarge
- Enter parameter values into Component Inspector

Note: The Interaction ID is a code for use when integrating Flash content into a learning management system such as Blackboard, WebCT, or Moodle. Learning management systems are beyond the scope of this text.

Note: Question form: This is where you ask the learners to perform a task. The default is "What animal has black and white stripes?" Replace that with your own question.

Note: The Response forms list the terms or phrases that are acceptable. Be sure to check the box to indicate the correct response. If you specifically want to exclude a term, type it in the response form without checking the correct box. The Fill in the Blank learning interaction can be evaluated for its case by checking the case sensitive box. You should check the Exact Match box if you require a response exactly as presented in a response form (the default is to accept the learner's response if it has any term in the response forms).



Set the Feedback Options

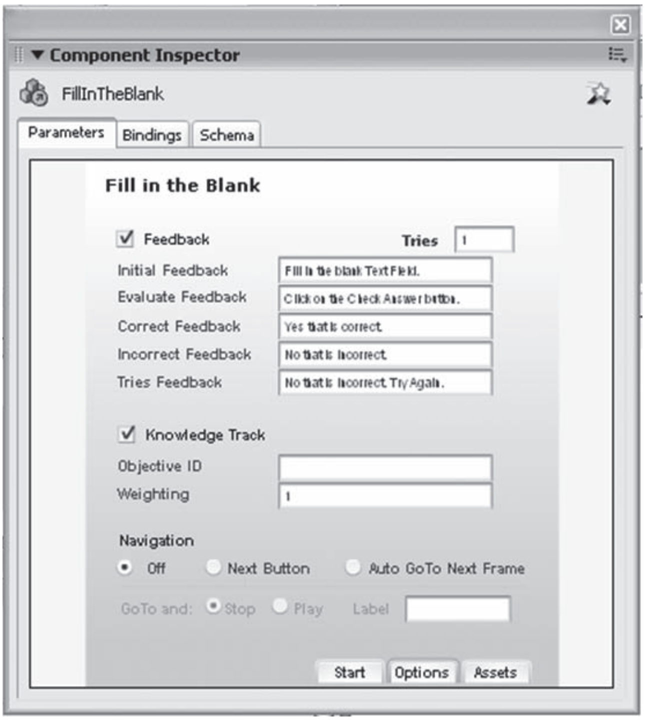
- Select the Options tab in the lower right-hand side of the Component Inspector.

Note: If you want to give the learners feedback, check the Feedback checkbox.

Note: The Initial Feedback form reports instructions to the users. The default is "Fill in the blank Text Field."

Note: The Evaluate Feedback form reports instructions on how to check their responses. The default is "Click on the Check Answer button."

Note: The Correct Feedback form is the report the learner receives if his or her response was correct. The default is, "Yes that is correct."



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: The Incorrect Feedback form is the report the learner receives if his or her response was incorrect. The default is, "No that is incorrect."

Note: The Tries Feedback form is the report the learner receives if his or her response is incorrect and he or she is allowed to try again (you can set the number of tries in the Tries form). The default is, "No that is incorrect. Try again."

- Assets, Bindings, and Scheme are features that can be used with a learning management system
- Set Navigation to off

Note: Navigation can either be turned off or you can create a Next Button that allows you to goto a specific frame on the Flash timeline (that frame must be labeled). You can also choose Auto GoTo Next Frame, which automatically moves the learner to the next frame.

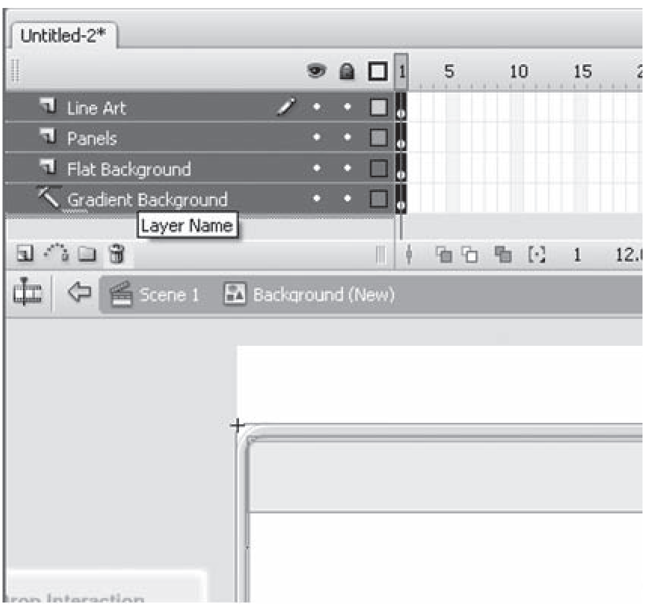
Note: Assets, Bindings, and Scheme are features that can be used with a learning management system.

- Hide the Component Inspector by clicking on its bar

Change the Background Placeholder Graphics

Note: The background graphic can be deleted or modified to make the learning component visually compatible with the rest of the application, while retaining its functionality.

- On the Scene 1 Timeline double click on the Background graphic
- Drag each layer to the trash can to remove the graphics



Test the Application

Note: At this point, you can test the application to determine whether it is functioning as expected.

- From the **Menu Bar,** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Summary

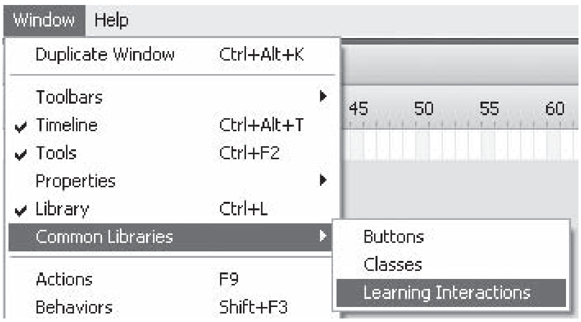
The Fill in the Blank learning interaction allows you to receive text input from the learners and evaluate it. This technique is particularly useful for practice situations that require one- or two-word responses. Unfortunately, this type of learning interaction becomes unwieldy with longer responses because of the limitations of Flash's response evaluation system; the learners must provide answers in a particular format and phrased in particular ways. For example, you might ask, "In which year is Columbus said to have 'discovered' America?" You may have set up the interaction to accept the response "1492"; unfortunately, the user may provide the response, "fourteen ninety-two." Both are equivalent with regard to meaning, but would not be evaluated as correct by Flash.

Learning Component: Hot Object

Flash has a set of pre-built learning components that allow you to construct interactions that allow you to test the learners. These components are essential online learning tools. You will be familiar with many of these interaction types. The Hot Object learning interaction works similar to a multiple-choice type question in that the users select their answers. However, the Hot Object tool makes it possible to make any graphic on the screen clickable as a response to a question. If the learner has made an acceptable response, he or she can receive supportive feedback.

FLASH GUIDE FOR HOT OBJECT

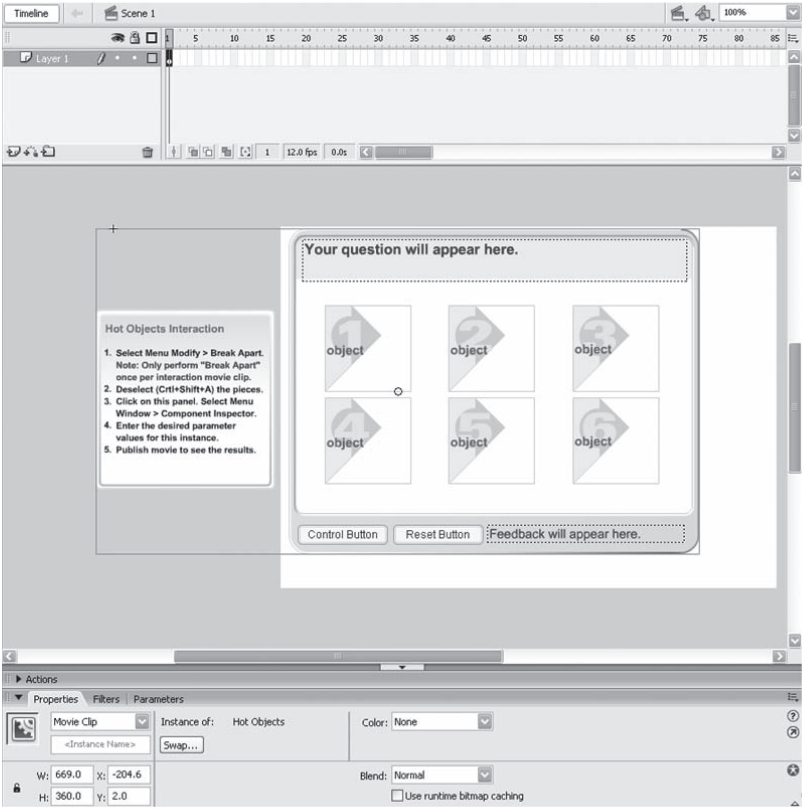
- Create a new Flash file
- Rename Layer 1 "Learning Interaction"
- Open the Learning Interactions library
    - From the Menu Bar, select Window, then Common Libraries, then Learning Interaction



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Drag the Hot Object Learning Interaction on to the Stage
- Position the Learning Interaction so that the Instruction box on the left hangs outside of the stage area

Note: Never delete the Instruction box, as it has important information for the learning interaction to operate properly. The Instruction box will not be visible when the application is run.



Break Apart the Interaction

- From the Menu Bar, select Modify, then Break Apart (Ctrl+B)
- Deselect all of the components
- From the Menu Bar, select Edit, then Deselect All (Ctrl+Shift+A)
- Select the Instruction box

View the Component Inspector

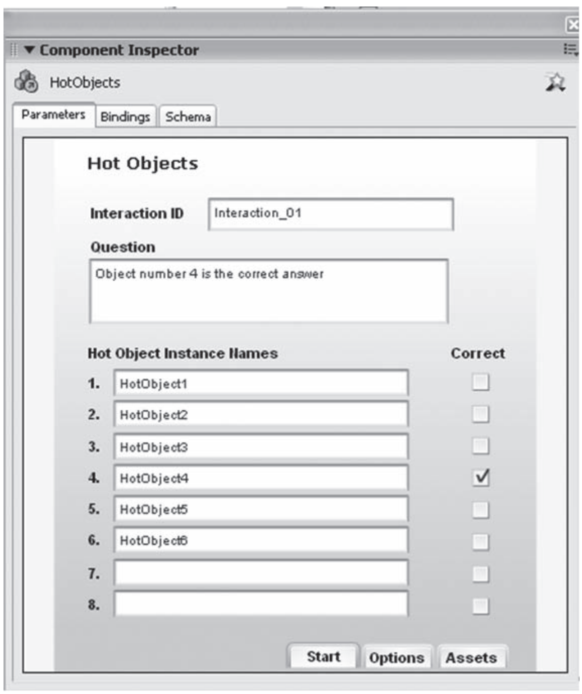
- From the Menu Bar, select Window, then Component Inspector (Shift+F7)
- Drag the lower-right pull corner of the Component Inspector to enlarge
- Enter parameter values into the Component Inspector

Note: The Interaction ID is a code for use when integrating Flash content into a learning management system such as Blackboard, WebCT, or Moodle. Learning management systems are beyond the scope of this text.

Note: Question form: This is where you ask the learners to perform a task. The default is "Object number 4 is the correct answer." Replace that with your own question.

Note: The Hot Object Instance Names forms list the names of the available objects. Be sure to check the box to indicate correct response. It is a good idea to name the objects with an identifier. For example, RobinHotObject1, ParrotHotObject2, PenguinHotObject3, SparrowHotObject4.

Note: If you do not require all of the Hot Objects, you can remove them by removing their names in the Component Inspector.



Set the Feedback Options

- Select the Options tab in the lower right-hand side of the Component Inspector

Note: If you want to give the learners feedback, check the Feedback checkbox.

Note: The Initial Feedback form reports instructions to the user. The default is "Click on an object to select it."

Note: The Evaluate Feedback form reports instructions on how to check their responses. The default is "Click on the Check Answer button."

Note: The Correct Feedback form is the report the learner receives if his or her response was correct. The default is, "Yes that is correct."

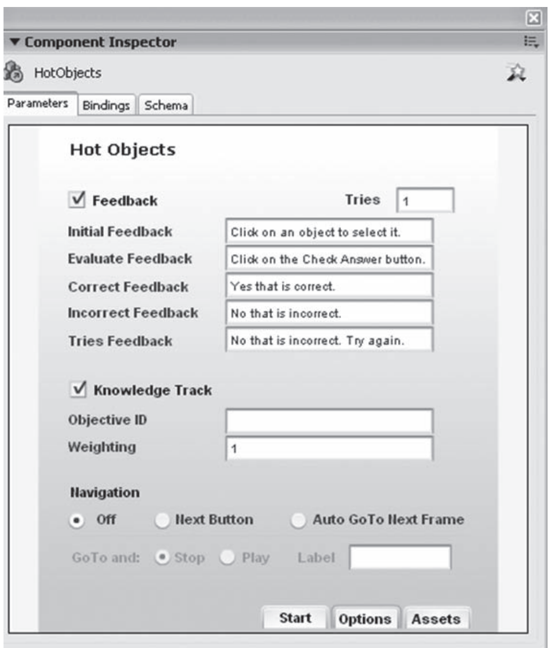
Note: The Incorrect Feedback form is the report the learner receives if his or her response was incorrect. The default is, "No that is incorrect."

Note: The Tries Feedback form is the report the learner receives if his or her response is incorrect and he or she is allowed to try again (you can set the number of tries in the tries form). The default is, "No, that is incorrect. Try again."

Note: Knowledge Track is a set of settings if this component is used in a learning management system.

- Set Navigation to off

Note: Navigation can either be turned off or you can create Next Button that allows you to goto a specific frame on the Flash timeline (that frame must be labeled). You can also choose Auto GoTo Next Frame which automatically moves the learner to the next frame.



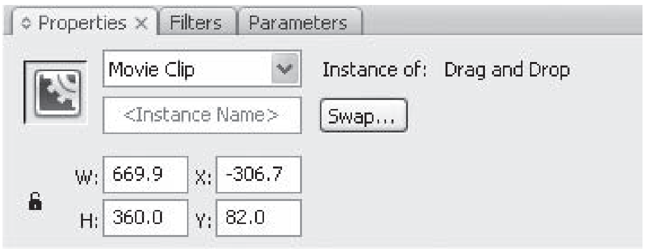
Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: Assets, Bindings, and Scheme are features that can be used with a learning management system.

- Hide the Component Inspector by clicking on its bar

Name the Hot Object Instances

- Select each Hot Object and name it in its Property Inspector (RobinHotObject1, SparrowHotObject2, etc.)



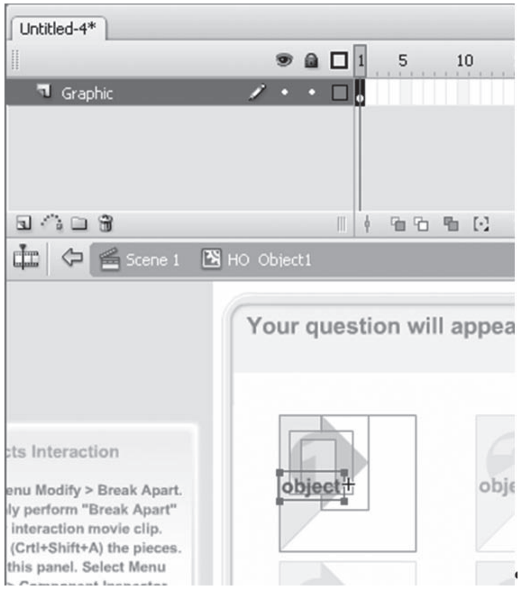
Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Replace the Placeholder Image

- Select and Double Click on the Object1 symbol on the stage

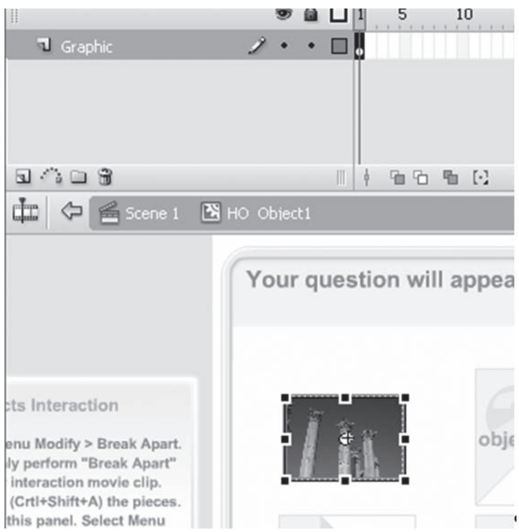
Note: Notice beneath the Timeline that there is an HO Object1 symbol icon. This tells you that you are working with the symbol Timeline and not the Scene 1 Timeline.

- Select all of the placeholder graphics by selecting the Keyframe on frame 1 of the graphics layer, the hitting the delete key



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- You can now import a graphic to use as act as the object
    - From the Menu Bar, select File, then Import, then Import to Stage, select an image, then select Open



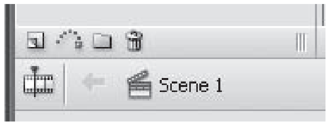
Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Repeat replacing the placeholder graphics for all of the Hot Objects

Change the Background Placeholder Graphics

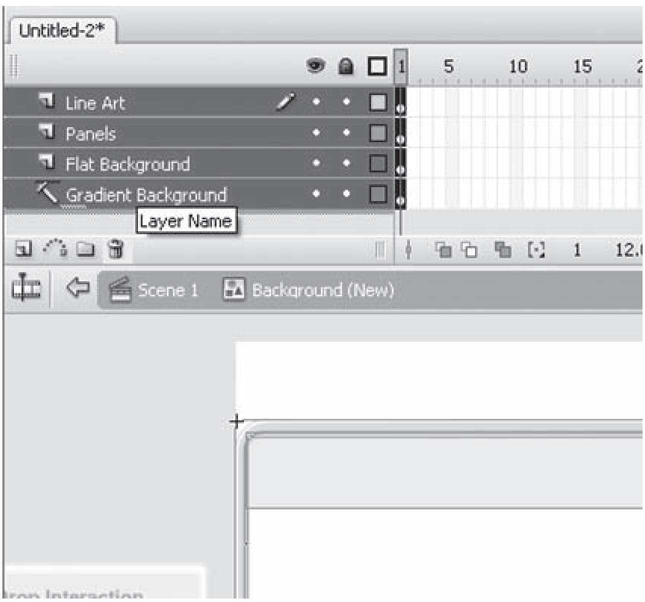
Note: The background graphic can be deleted or modified to make the learning component visually compatible with the rest of the application while retaining its functionality.

- On the Scene 1 Timeline, double click on the Background graphic



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Drag each layer to the trash can to remove the graphics



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Test the Application

Note: At this point, you can test the application to determine whether it is functioning as expected.

- From the **Menu Bar,** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Summary

The Hot Object learning interaction allows you to create practice sequences that select particular graphics on the screen. With the Hot Object learning interaction, you can be very precise because anything that is not part of the target graphic will not be active. This is particularly helpful if you have a large number of graphics that you have produced outside of Flash. By using the Hot Object learning interaction, you can use these graphics with minimal positioning. Any time you need to have the users make a selection, the Hot Object learning interaction can be helpful.

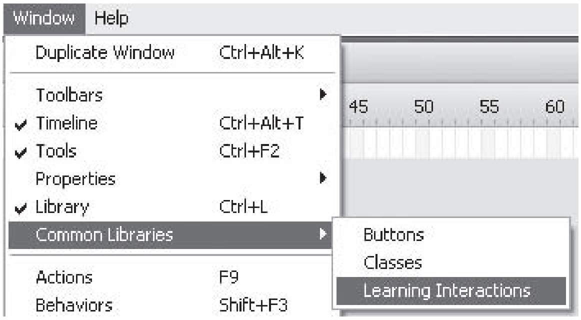
Learning Component: Hot Spot

Flash has a set of pre-built learning components that allow you to construct interactions that allow you to test the learner. These components are essential online learning tools. You will be familiar with many of these interaction types. The Hot Spot learning interaction works similar to a Hot Object type question in that the users select their answers by selecting a point on the stage. However, the Hot Spot tool makes a region of the stage clickable instead of the pixels of a specific graphic. If the learner has made an acceptable response, he or she can receive supportive feedback.

FLASH GUIDE FOR HOT SPOT

Create a Hot Spot

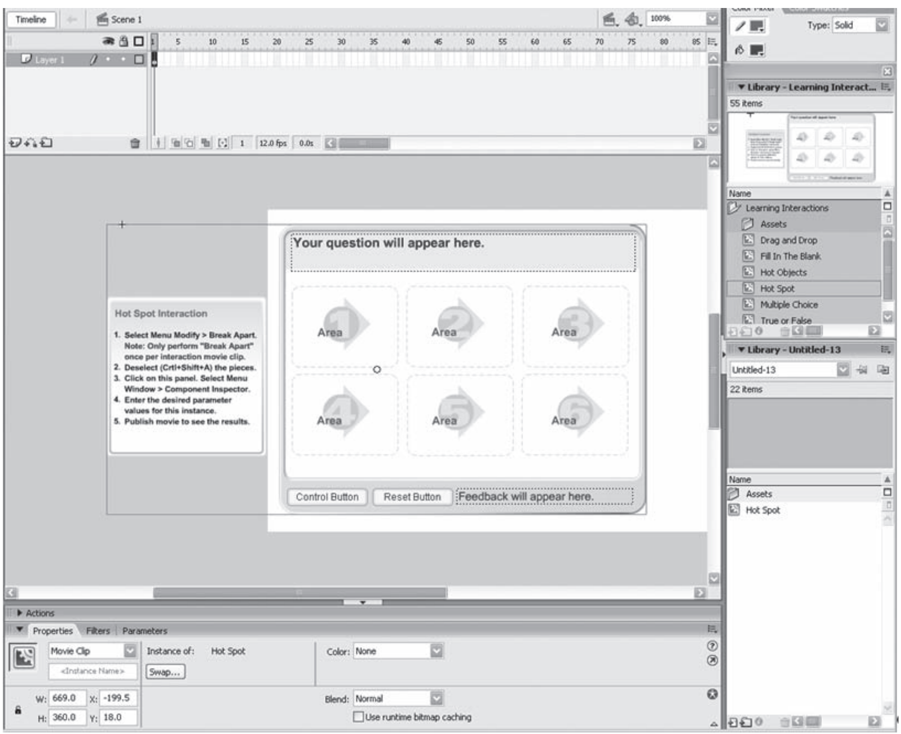
- Create a new Flash file
- Rename Layer 1 "Learning Interaction"
- Open the Learning Interactions library
    - From the Menu Bar, select Window, then Common Libraries, then Learning Interaction



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Drag the Fill in the Blank Learning Interaction onto the Stage
- Position the Learning Interaction so that the Instruction box on the left hangs outside of the stage area

Note: Never delete the Instruction box, as it has important information for the learning interaction to operate properly. The instruction box will not be visible when the application is run.

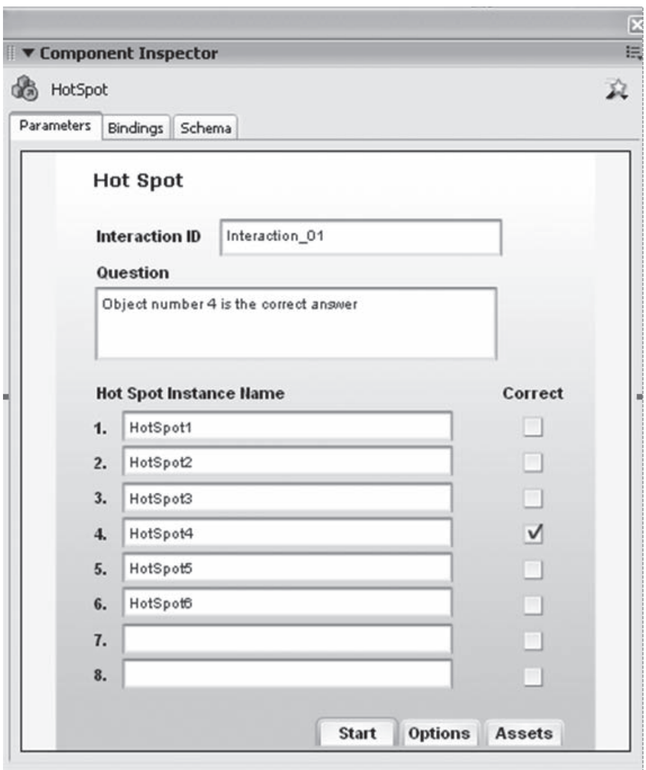


Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Break Apart the Interaction

- From the Menu Bar, select Modify, then Break Apart (Ctrl+B)
- Deselect all of the components
    - From the Menu Bar, select Edit, then Deselect All (Ctrl+Shift+A)
- Select the Instruction box
- View the Component Inspector
    - From the Menu Bar, select Window, then Component Inspector (Shift+F7)
    - Drag the lower-right pull corner of the Component Inspector to enlarge
- Enter parameter values into Component Inspector

Note: The Interaction ID is a code used when integrating Flash content into a learning management system such as Blackboard, WebCT, or Moodle. Learning management systems are beyond the scope of this text.



Note: Question form: This is where you ask the learners to perform a task. The default is "Object number 4 is the correct answer." Replace that with your own question.

Note: The Hot Spot Instance Names forms list the names of the available objects. Be sure to check the box to indicate a correct response. It is a good idea to name the objects with an identifier. For example, RobinHotSpot1, ParrotHotSpot2, PenguinHotSpot3, SparroHotSpot4.

Note: If you do not require all of the Hot Spots, you can remove them by removing their names in the Component Inspector.

Set the Feedback Options

- Select the Options tab in the lower right-hand side of the Component Inspector

Note: If you want to give the learners feedback, check the Feedback checkbox.

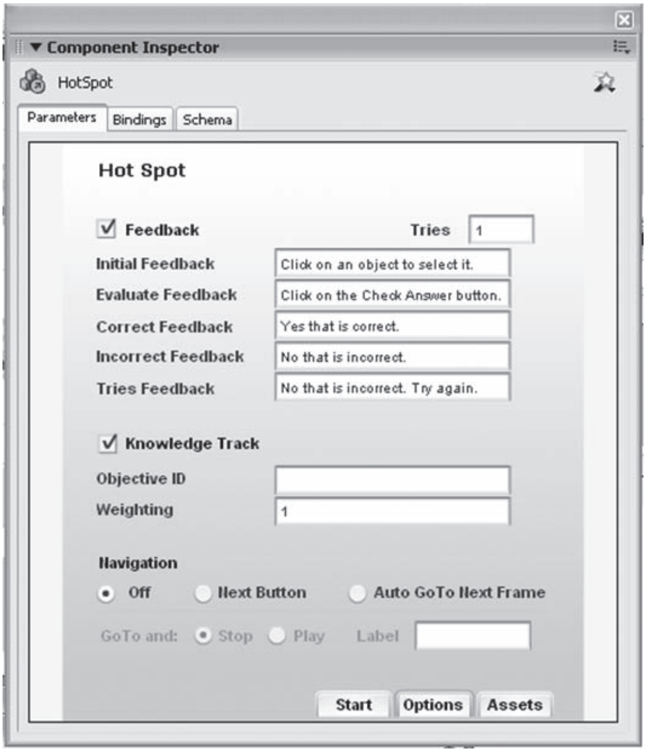
Note: The Initial Feedback form reports instructions to the user. The default is "Click on an object to select it."

Note: The Evaluate Feedback form gives instructions on how to check their responses. The default is "Click on the Check Answer button."

Note: The Correct Feedback form is the report the learner receives if his or her response was correct. The default is, "Yes that is correct."

Note: The Incorrect Feedback form is the report the learner receives if his or her response was incorrect. The default is, "No that is incorrect."

Note: The Tries Feedback form is the report the learner receives if his or her response is incorrect and he or she is allowed to try again (you can set the number of tries in the tries form). The default is, "No that is incorrect. Try again."



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: Knowledge Track is a set of settings when this component is used in a learning management system.

- Set Navigation to off

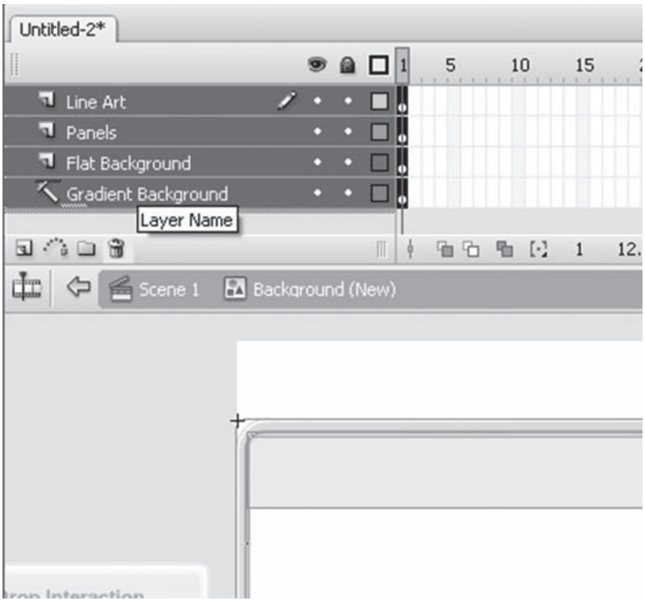
Note: Navigation can either be turned off or you can create a Next Button that allows you to goto a specific frame on the Flash timeline (that frame must be labeled). You can also choose Auto GoTo Next Frame, which automatically moves the learner to the next frame.

Note: Assets, Bindings, and Scheme are features that can be used with a learning management system.

- Hide the Component Inspector by clicking on its bar
- Change the background placeholder graphics

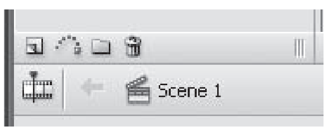
Note: The background graphic can be deleted or modified to make the learning component visually compatible with the rest of the application while retaining its functionality.

- On the Scene 1 Timeline, double click on the Background graphic



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Drag each layer to the trash can to remove the graphics
- Select Scene 1 to go up to the main timeline



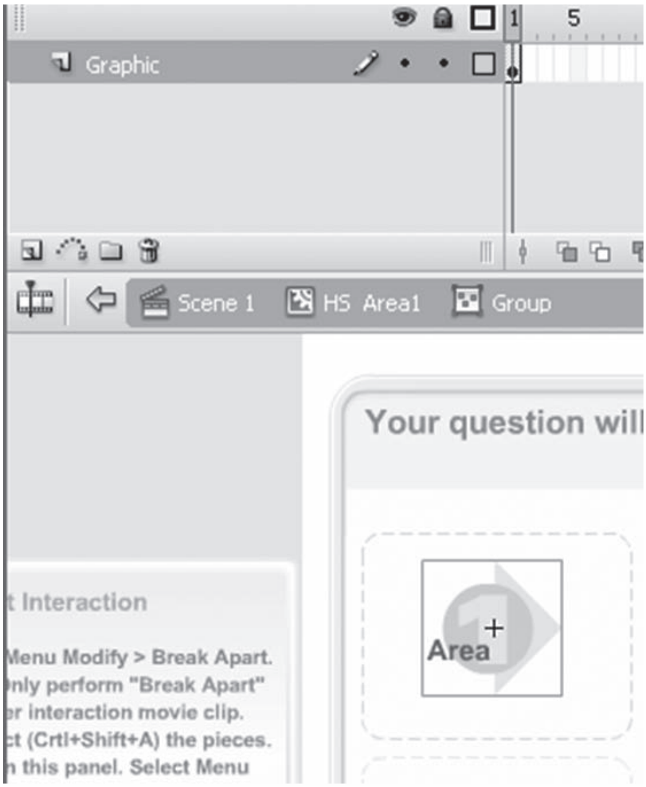
Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Remove the Placeholder Image

- Select and Double Click on the Area1 symbol on the stage

Note: Notice beneath the Timeline that there is an HS area1 symbol icon, which tells you that you are working with the symbol Timeline and not the Scene 1 Timeline.

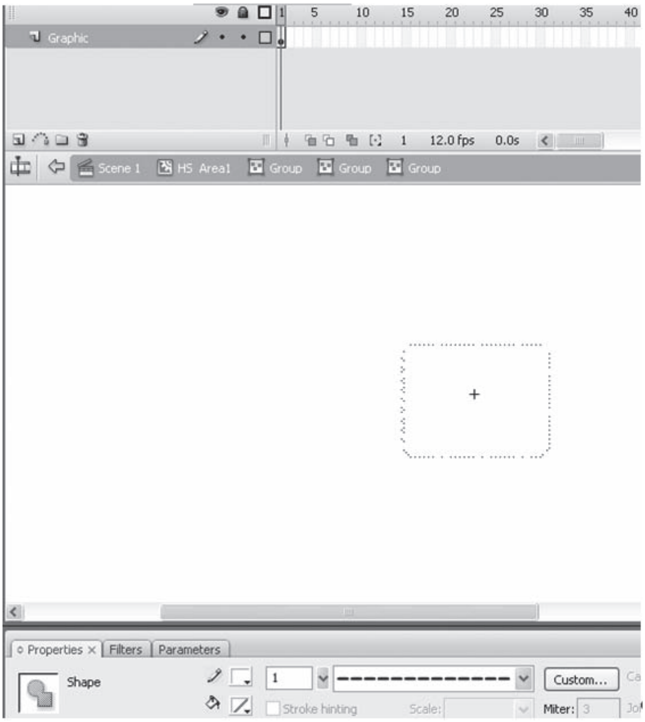
- Double click again to edit the graphics within the HS area1 symbol
- Delete the "inner graphics" by selecting the Keyframe of the Graphic layer and hitting the delete key



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Reset color of Area Box to white (#FFFFFF)

Note: The Hot Spot Learning Interaction needs a graphic to define an area. If you set the outer box to white, it will blend in with the background (set it to whatever background color is being used).

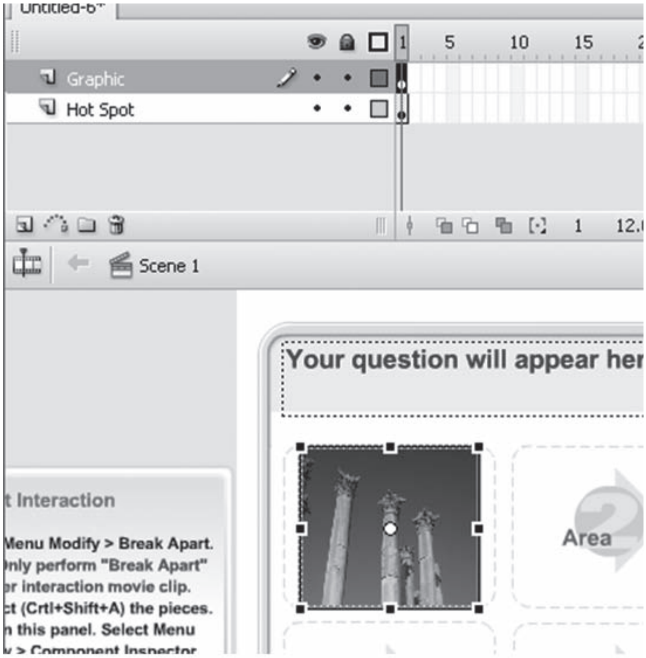


Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Rename the HSarea1 instance to SparrowHotSpot

Note: The HotSpot must be named the same thing that you previously named it in the Component Inspector.

  - Navigate back to the main Timeline and drag the HS area1 symbol to the spot it is needed
  - Use the transformation tool to resize the HS area1 symbol
  - Repeat removing the placeholder graphics for all of the Hot Spots
- Place graphics underneath Hot Spot Areas
  - Create new layer and name it "graphics" on the main timeline
  - Import a graphic to the stage on Frame 1 of the graphics layer



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Test the Application

Note: At this point, you can test out the application to determine whether it is functioning as expected.

- From the **Menu Bar** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Summary

The Hot Spot learning interaction is ideal for practice sequences that require the learners to select detailed items on the screen, particularly, if these items are embedded in a larger graphic. For example, if you asked the learners to "Please select the region of the painting that best illustrates the 'power of three's' principle, you would use the Hot Spot learning interaction. By using the transformation tool to reposition the selection, you can create a Hot Spot

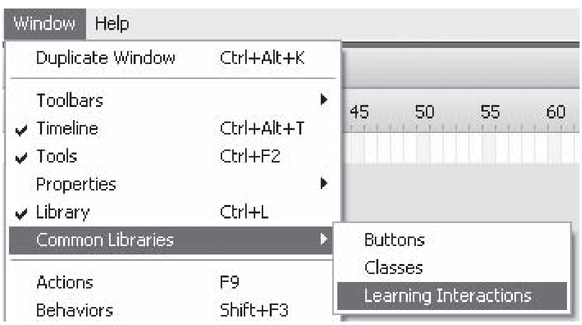
of any shape and size. The Hot Spot learning interaction allows you to have the learners perform in context.

Learning Component: Multiple Choice

Flash has a set of pre-built learning components that allow you to construct interactions that allow you to test the learners. These components are essential online learning tools. You will be familiar with many of these interaction types. The Multiple Choice tool allows the learners to select a response to a question. If a learner has made an acceptable response, he or she can receive supportive feedback.

FLASH GUIDE FOR MULTIPLE CHOICE

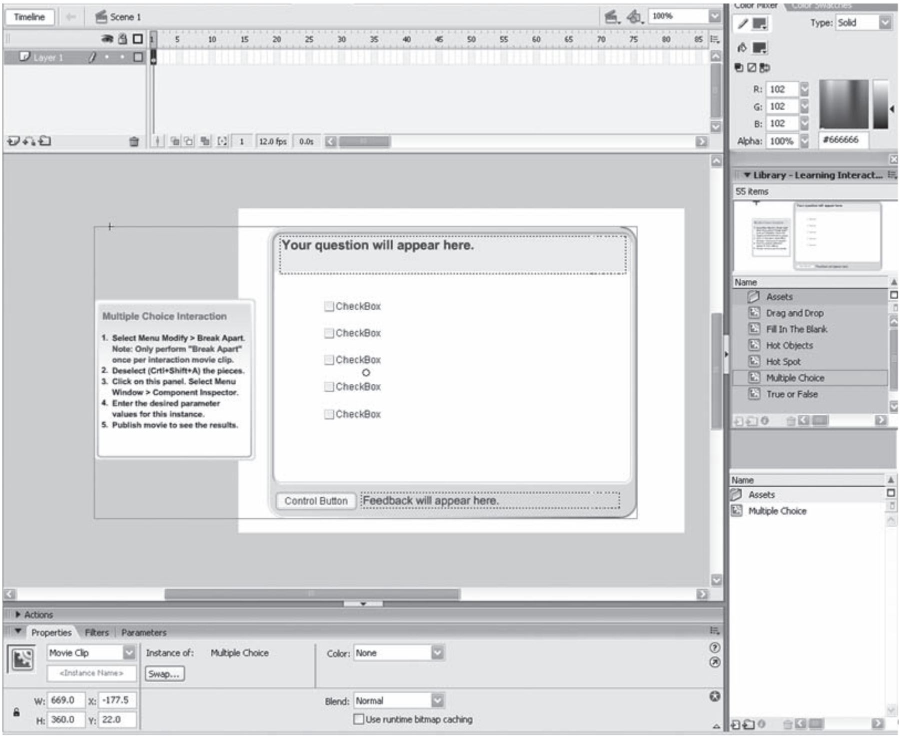
- Create a new Flash file
- Rename Layer 1 "Learning Interaction"
- Open the Learning Interactions library
  - From the Menu Bar, select Window, then Common Libraries, then Learning Interaction



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Drag the Multiple Choice Learning Interaction onto the Stage
- Position the Learning Interaction so that the Instruction box on the left hangs outside of the stage area

Note: Never delete the Instruction box, as it has important information for the learning interaction to operate properly. The instruction box will not be visible when the application is run.



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Break Apart the Interaction

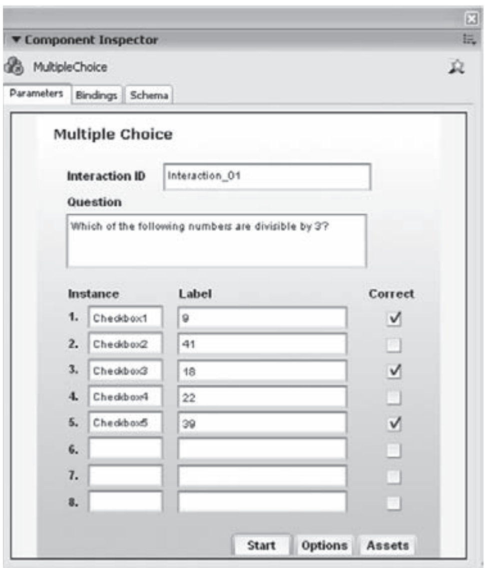
- From the Menu Bar, select Modify, then Break Apart (Ctrl+B)
- Deselect all of the components
  - From the Menu Bar, select Edit, then Deselect All (Ctrl+Shift+A)
- Select the Instruction box
- View the Component Inspector
  - From the Menu Bar, select Window, then Component Inspector (Shift+F7)
  - Drag the lower-right pull corner of the Component Inspector to enlarge
- Enter parameter values into Component Inspector

Note: The Interaction ID is a code used when integrating Flash content into a learning management system such as Blackboard, WebCT, or Moodle. Learning management systems are beyond the scope of this text.

Note: Question form: This is where you ask the learners to perform a task. The default is "Which of the following numbers are divisible by 3?" Replace that with your own question.

Note: The Instance forms are the names of the checkboxes. It is a good idea to rename these so that they are easy to match with the labels. For example, checkbox1, checkbox2, checkbox3, and checkbox4 can be renamed to RobinCheckbox1, Penguin-Checkbox2, SparrowCheckbox3, and EagleCheckbox4.

- Insert answer options in the Label forms. Be sure to indicate which answers are correct in the checkbox next to the Label forms.



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Set the Feedback Options

- Select the Options tab in the lower right-hand side of the Component Inspector

Note: If you want to give the learners feedback, check the Feedback checkbox.

Note: The Initial Feedback form reports instructions to the users. The default is "Click on a Checkbox."

Note: The Evaluate Feedback form gives learners instructions on how to check their responses. The default is "Click on the Check Answer button."

Note: The Correct Feedback form is the report the learner receives if his or her response was correct. The default is, "Yes that is correct."

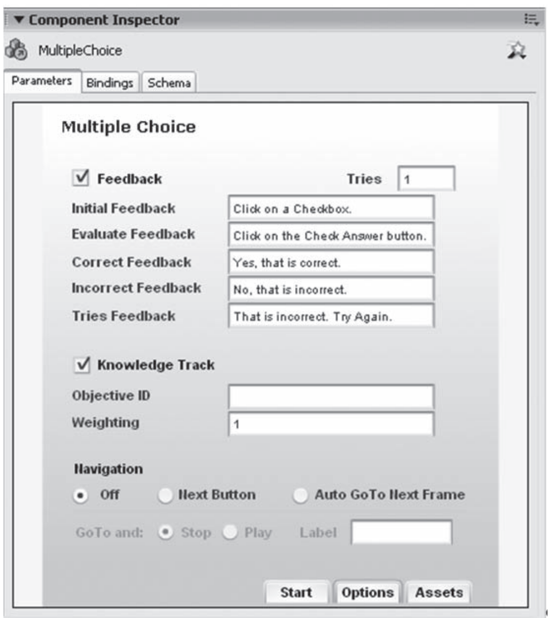
Note: The Incorrect Feedback form is the report the learner receives if his or her response was incorrect. The default is, "No that is incorrect."

Note: The Tries Feedback form is the report the learner receives if his or her response is incorrect and he or she is allowed to try again (you can set the number of tries in the tries form). The default is, "No that is incorrect. Try again."

Note: Knowledge Track is a set of settings for when this component is used in a learning management system.

Set Navigation to Off

Note: Navigation can either be turned off or you can create a Next Button that allows you to goto a specific frame on the Flash timeline (that frame must be labeled). You can also choose Auto GoTo Next Frame, which automatically moves the learners to the next frame.



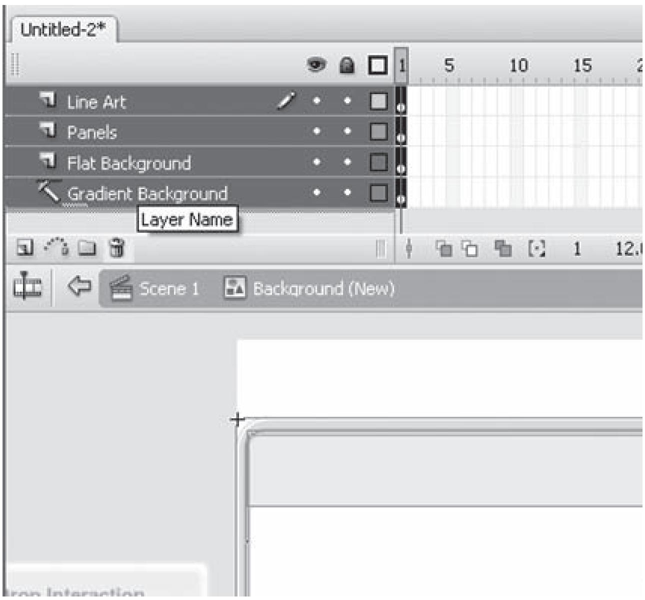
Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: Assets, Bindings, and Scheme are features that can be used with a learning management system.

- Hide the Component Inspector by clicking on its bar
- Change the background placeholder graphics

Note: The background graphic can be deleted or modified to make the learning component visually compatible with the rest of the application while retaining its functionality.

- On the Scene 1 Timeline, double click on the Background graphic
- Drag each layer to the trash can to remove the graphics



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- Return to the main timeline by selecting Scene 1

Test the Application

Note: At this point, you can test out the application to determine whether it is functioning as expected.

- From the **Menu Bar** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Summary

A multiple-choice type question is the prototypical practice and assessment instrument. It is a particularly important tool for addressing the initial learner action part of a Select, Edit, Produce practice sequence. A multiple-choice question gives the learners an opportunity to select from a set of given choices. It should also be noted that multiple-choice questions must be designed to address a specific objectives. Too often, multiple-choice questions are written to address Facts, even if the learning objective is clearly in a another domain such as the Conceptual one. For example, it might be tempting to write a multiple-choice question such as:

Art deco can be defined as:

1. An architectural style of the period 1925–1940
2. An architectural style of the period 1935–1950
3. An architectural style of the period 1945–1960
4. An architectural style of the period 1955–1970

However, that question targets the Fact learning domain. If the learning objective were classified as part of the Concept learning domain, the question would be better stated:

An example of the art deco architectural style is:

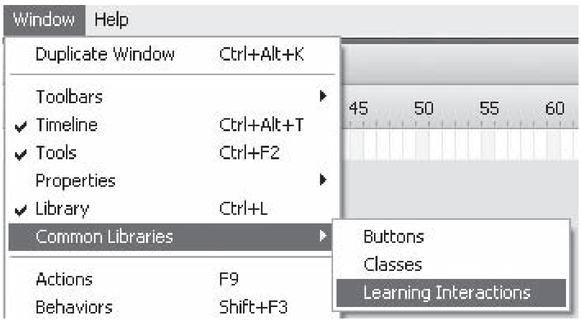
1. The Chrysler building in New York City
2. The John Hancock building in Chicago
3. The National Gallery of Canada in Ottawa
4. The Venice Beach House in Venice

Learning Component: True or False

Flash has a set of pre-built learning components that allow you to construct interactions that allow you to test the learners. These components are essential online learning tools. You will be familiar with many of these interaction types. The True or False tools allow learners to select one answer that is true. If a learner has made an acceptable response, he or she can receive supportive feedback.

FLASH GUIDE FOR TRUE OR FALSE

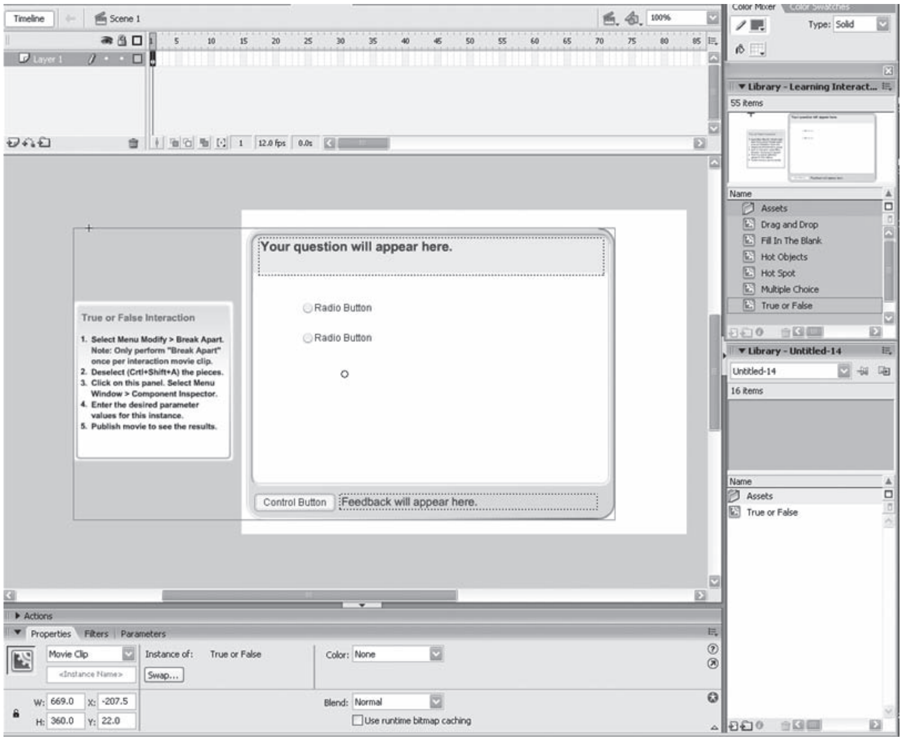
- Create a new Flash file
- Rename Layer 1 "Learning Interaction"
- Open the Learning Interactions library
    - From the Menu Bar, select Window, then Common Libraries, then Learning Interaction



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

- Drag the True or False Learning Interaction onto the Stage
- Position the Learning Interaction so that the Instruction box on the left hangs outside of the stage area

Note: Never delete the Instruction box, as it has important information for the learning interaction to operate properly. The instruction box will not be visible when the application is run.



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Break Apart the Interaction

- From the Menu Bar, select Modify, then Break Apart (Ctrl+B)
- Deselect all of the components
    - From the Menu Bar, select Edit, then Deselect All (Ctrl+Shift+A)
- Select the Instruction box
- View the Component Inspector
    - From the Menu Bar, select Window, then Component Inspector (Shift+F7)
    - Drag the lower-right pull corner of the Component Inspector to enlarge
- Enter parameter values into Component Inspector

Note: The Interaction ID is a code for use when integrating Flash content into a learning management system such as Blackboard, WebCT, or Moodle. Learning management systems are beyond the scope of this text.

Note: Question form: This is where you ask the learners to perform a task. The default is "The sky is blue." Replace that with your own question.

Note: The Distracter forms are the label of the learners' choices. By default, the choices are "A. True" and "B. False," although you could change them to something like "A. Yes" and "B. No."

- Be sure to indicate which answer is correct in the radio button next to the Distracter forms

Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Set the Feedback Options

- Select the Options tab in the lower right-hand side of the Component Inspector

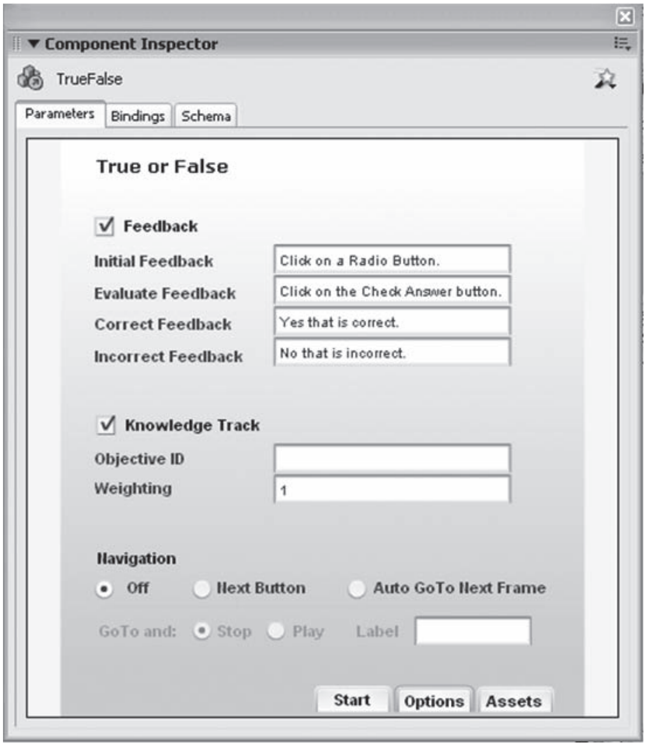
Note: If you want to give the learners feedback, check the Feedback checkbox.

Note: The Initial Feedback form reports instructions to the users. The default is "Click on a Radio Button."

Note: The Evaluate Feedback form reports instructions on how to check their responses. The default is "Click on the Check Answer button."

Note: The Correct Feedback form is the report the learner receives if his or her response was correct. The default is, "Yes that is correct."

Note: The Incorrect Feedback form is the report the learner receives if his or her response was incorrect. The default is, "No that is incorrect."



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Note: Knowledge Track is a set of settings when this component is used in a learning management system.

- Set Navigation to off

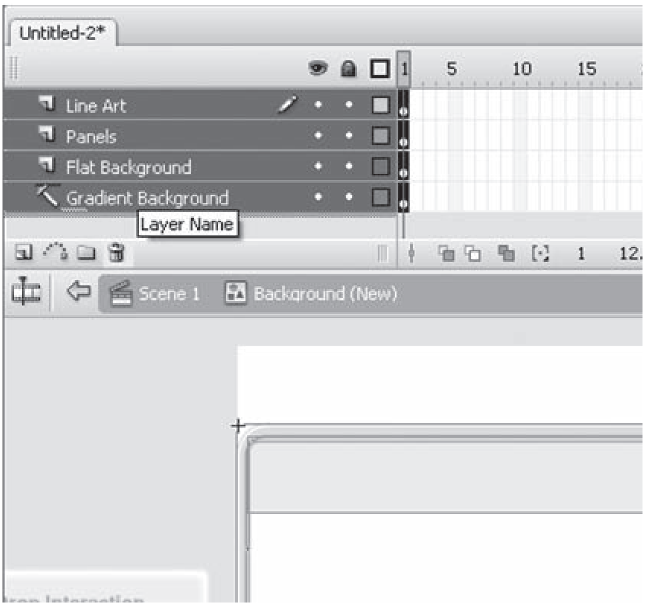
Note: Navigation can either be turned off, or you can create a Next Button that allows you to goto a specific frame on the Flash timeline (that frame must be labeled). You can also choose Auto GoTo Next Frame, which automatically moves the learner to the next frame.

Note: Assets, Bindings, and Scheme are features that can be used with a learning management system.

- Hide the Component Inspector by clicking on its bar
- Change the background placeholder graphics

Note: The background graphic can be deleted or modified to make the learning component visually compatible with the rest of the application while retaining its functionality.

- On the Scene 1 Timeline, double click on the Background graphic
- Drag each layer to the trash can to remove the graphics



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

Test the Application

Note: At this point, you can test out the application to determine whether it is functioning as expected.

- From the **Menu Bar,** *select* **Control** and then choose **Test Movie**

Note: When you Test Movie, a .swf file is created and you can view what your learners will see.

Summary

The True or False type question is one of the easiest to implement in Flash. From a design point of view, the True or False question is a quick method for providing practice opportunities to the learners. It lets you know whether the learners have grasped some basic core relationships.

Summary

The important features presented in this chapter include:

- Flash drawing tools
- Flash symbols
- Flash animation types
- Flash text tools
- Flash learning components
- Flash masks
- Flash motion guides
- Flash sounds and video

COMING UP: FACTS

In the next chapter, you will be introduced to learning domains. You will learn how to distinguish the Fact learning domain from the others. You will learn about how to design instruction for the Facts learning domain. In particular, you will learn how to develop appropriate presentation and practice sequences targeted at the sensory memory, working memory, and long-term memory systems.

8

Facts

Guiding Questions

- How do you identify instances of the Facts learning domain?
- What strategies are appropriate for presenting content in the Facts learning domain?
- What sequences are appropriate for practicing content in the Facts learning domain?

Chapter Overview

In this chapter, you will learn about teaching Facts, often considered the most difficult learning domain to teach. Facts are essentially arbitrary associations. For example, "Columbus discovered America in 1492" is a Fact because the date, "1492," is associated with the statement, "Columbus discovered America." Facts are challenging to teach because the learner must memorize

the association. With the other learning domains (Concepts, Principles, and Procedures), we can assist the learners by providing them with a meaningful structure in which we can embed information. Learning is easier when meaningful connections can be made to prior knowledge. However, Facts are the least amenable domain for creating structures because often the associations are arbitrary. Effective strategies for creating a structure for Facts include elaborative verbal explanations and carefully designed repetition sequences.

The Nature of Facts

What is a Fact? First, instructional designers use the term "Fact" differently than does the general public. Most people think of Facts as true or verifiable propositions; a useful designation because they allow one to create a logical distinction between assertions that are true and assertions that are false. In this sense, if a statement is false then it is not a Fact.

However, when we are discussing Facts from an instructional designer's point-of-view, as a learning domain, we are interested in being able to recognize and recall the associations, assertions, and propositions themselves and not with determining whether they are true. It is the association that is important, and not the veracity of the proposition.

Merrill (1983) describes Facts as "arbitrarily associated pieces of information such as a proper name, a date or an event, the name of a place or the symbols used to name particular objects or events" (p. 287). Questions such as, "On an interstate highway ramp, what is the sign for Yield?" and "What is the value of the U.S. national debt" are Fact-based questions; each of these propositions proposes an association that the learner must recognize or recall.

Facts, sometimes labeled as declarative knowledge or verbal information, may include what is called organized discourse, which consists of a sequence of Facts leading to an extended meaning. Learners understand organized discourse by following a chain of reasoning. For example, the statement, "The author that recommends the recipe be made either outdoors or in commercial kitchen, since the process creates an incredible amount of smoke that will set off your own and your neighbors' smoke alarms" (Wu, 2007), is a declarative statement that requires the learner to recall a set of integrated associations.

In most cases, learners must memorize Facts. The less arbitrary the elements of a Fact are, the easier they are to memorize (Ausubel, 2000). This is because knowledge is stored in our brains as a set of neuron associations and connections (Zull, 2002). The more neuron associations a Fact connects to, the more easily it can be recalled. For example, Facts, when in the form of organized discourse, are relatively easy to recall because there is a context provided. However, Facts such as recalling one's social security number are more difficult because the number sequence is essentially arbitrary.

General Strategy

When teaching Facts, as with any learning domain, you will have to make a decision as to whether your will use a direct strategy (guided presentation and practice) or a discovery strategy (learners construct their experience). This text focuses on direct strategies; however, you should be familiar with discovery strategies as well because there are situations in which increasing the learners' responsibility for their learning is appropriate.

A direct instructional strategy for the Fact domain consists of presenting the learners with the Facts and clarifying which associations you expect the learners to make. A discovery instructional strategy could involve asking the learners to search for information required to make an association. For example, you could ask the learners to conduct a web search for the dates of the Act of Toleration, Leisler's Rebellion, and the Glorious Revolution. A direct strategy would simply have provided the learners with this information directly, which has the advantage of being quick and accurate. The discovery approach is a bit more cumbersome, but has the advantage of providing context for the learners, which may assist them in long-term retention.

Demonstrating Mastery

To demonstrate mastery of an objective classified in the Fact learning domain, the learner will have to be able to associate parts of propositions with their counterparts.

Presentation Strategies

Fact presentations consists of three types of strategies: (1) attention management, (2) cognitive load management, and (3) structural management that all align with sensory memory, working memory, and long-term memory. In some cases, all of these strategies could be used to teach an instructional objective; however, often a small set of strategies will be sufficient.

Attention Management

Clarity When instructing the learners on an association or verbal discourse, the prose should be focused and organized for easy readability. The learners should not have to work to understand the association. Writing for instructional software should keep the learners' interest.

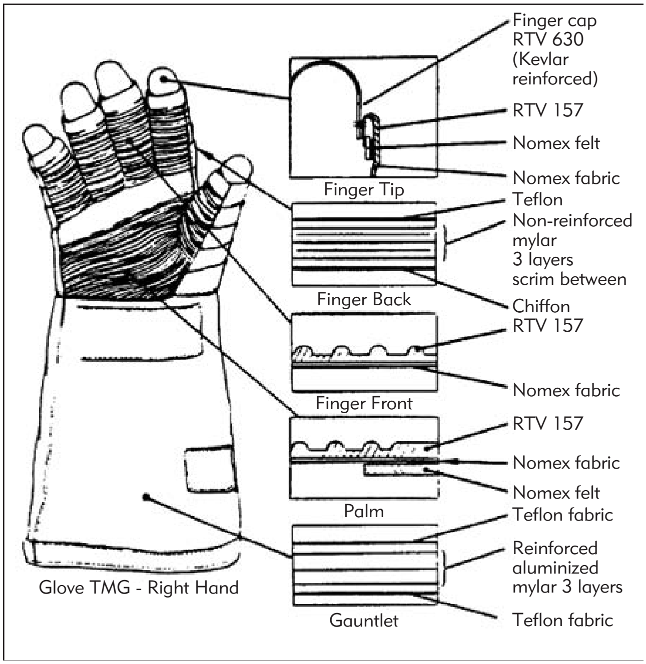
Figure/Ground Separation One of the simplest things an instructional designer can do to enhance the learning of Facts is to make the required associations as clear as possible. Often this involves isolating the elements to be associated from a cluttered background. For example, to a novice the organs in the body are difficult to differentiate from one another. If a learner studies anatomy, you would want to provide him or her with an illustration that highlights a particular organ, you do this because it allows the learner to identify which organ is under discussion.

In the same way, if you are teaching learners to associate the symbols in an electrical circuit diagram with their names, you will have to make it clear which symbol you are discussing. A circuit diagram may have twenty or thirty different symbols; to assist the learners in making the appropriate association you must find a method that focus the learners' attention on a particular symbol when you mention its label.

This is a figure/ground problem (Lohr, 2007). To demonstrate an association, the figure (what you are referring to) is separated from the ground (everything else). This type of separation is critical for the most basic communication about Facts to occur. The learners must know what the association is before they can hope to retain it.

Figure 8.1. Cluttered Diagram.

http://msis.jsc.nasa.gov/sections/section14.htm



Separating a figure from its ground can be difficult to accomplish with a paper text. Paper only allows you to use arrows or colors to separate the figure from the ground in a static fashion. Often, a display in a paper document appears cluttered, as in the diagram in Figure 8.1.

A medium like Flash, however, allows you to show associations one at a time. Instead of sharing the page with every possible label, we can create an interaction that allows the learners to select an item and simultaneously view its label. That way there is no ambiguity, and the learners can focus their attention appropriately.

Layout Many Facts come in the form of verbal discourse or narratives, which are not amenable for display in diagrams like the one in Figure 8.1. In these cases, we expect the learners to comprehend text and summarize it. We can assist

the learners by organizing the text with headings, subheading, and perhaps by highlighting critical passages or terms. These techniques help the learners focus their attention productively. For example, the passage:

> "A relief pitcher or reliever is a baseball or softball pitcher who enters the game after the starting pitcher is removed due to injury, ineffectiveness or fatigue. Relievers are further divided informally into closers, middle relief pitchers, left-handed specialists, set-up pitchers and long relievers,"
>
> *(http://en.wikipedia.org/wiki/Relief_pitcher)

may be modified, as follows, to improve its comprehensibility:

> "A **relief pitcher** or **reliever** is a baseball or softball pitcher who **enters** the game after the **starting pitcher is removed** due to injury, ineffectiveness or fatigue."

Stressing the important ideas and eliminating extraneous text makes the chain of reasoning easier to follow and the content more memorable.

Cognitive Load Management

Learning Domain Knowledge The Fact learning domain is unique in that the learner is likely to have to memorize many of the associations. Learners should be aware that they will have to engage in behavior that encourages memorization.

Highlight Goals An important strategy for reducing cognitive load is to ensure that the learners are aware of the instructional objectives. If learners knows what the goals are, they can focus on tasks that will help them reach those goals instead of diffusing their thoughts in other areas. Objectives for the Fact learning domain are described by action verbs, such as associate, list, and match, among others. For example, the following demonstrate Fact instructional objectives.

- The learner will be able to list the elements in Maslow's hierarchy of needs.
- The learner will be able to describe the traffic law regarding four-way stops.

- The learner will be able to associate the appropriate Braille symbol with the letter "r."
- The learner will be able to select the appropriate definition for the label, "kidney."

To teach Facts successfully, it is important that the learner know something about the domain. Each learning domain requires different strategies for their achievement. By informing the learners of these domains, they can prepare themselves to focus on the tasks at hand. Facts are the most basic of the learning domains. Knowledge from the other learning domains is generally not prerequisites for learning Facts. While organized discourse may reference Concepts, Principles, and Procedures, they are rarely the object of analysis when learning Facts. For example, in the statement, "January 11, 1689, The Parliament of England declared King James II of England deposed," the learner is confronted with the Concepts of Parliament, king, and deposed. However, the Fact domain task is to associate the date with the event. Of course, in this case, a holistic understanding would emerge from learning both the Facts and Concepts involved in the statement.

Graphic Organizer Managing cognitive load is an important factor in teaching Facts. Extraneous and unorganized information puts more of a burden on the learners' cognitive resources than necessary. A graphic organizer is an effective method of visually organizing information for learners. Graphic organizers are particularly helpful for identifying, organizing, and demonstrating relationships among Facts (Smith & Ragan, 2005).

Graphic organizers can be diagrams or pictures used to demonstrate how ideas relate to one another. Graphic organizers help demonstrate relationships that may not be apparent to the learners and may assist them in retaining the material. A timeline of historic events or a table listing and comparing the characters of two novels are forms of graphic organizers. For example, after learning the Concept of a "straight man" (an archetypal comic foil), a learner might need to learn supporting examples of the idea. Learning to associate sets of comics with their straight men is a task of the Fact learning domain. Laying this information out in a grid makes it easy to make the appropriate associations. Table 8.1 provides an example of a graphic organizer.

Table 8.1. Graphic Organizer for Comic Duos.

Comic	*Straight-Man*
Penn Jillette	Teller
George Burns	Gracie Allen
Bud Abbott	Lou Costello
John Hodgman	Justin Long
Cheech Marin	Tommy Chong
Bart Simpson	Lisa Simpson

Unit Size The primary variable for reducing cognitive load when teaching Facts is reducing unit size in one of two ways: (1) reduce what constitutes a unit or (2) reduce the number of units. An association between a label and a definition constitutes a unit. You cannot shorten a label; however, you can select a corresponding definition version that is either basic or advanced. You can initially supply the learners with a simple definition and later expand it once the learners have mastered the initial association. For example, you could introduce the Fact "catalyst" as follows:

> "A substance that speeds up a chemical reaction"

Later, you could provide an expanded definition such as:

> "Chemicals that are not consumed in a reaction, but that speed up the reaction rate." (misterguch.brinkster.net/vocabulary.html).

Your second option is to reduce the number of units you teach at any one time. For example, associating a list of ten vocabulary words with their definitions is an easier task than learning a list of twenty words. It might be a more productive strategy to have your learners master the smaller set before moving on to the larger set.

Structural Management

Elaboration Structural management is an attempt to encourage the learners to integrate the new information they encounter with their long-term memory. One of the main jobs of an instructional designer is to demonstrate a meaningful connection within and among Facts. The more connections that the learners can identify, the more likely it is that information will find itself embedded in the learners' memory structure (Zull, 2002).

For example, the chemical symbol for the element potassium is K. To the casual learner, there is not any particular reason why the letter K is associated with the element potassium. The association is essentially arbitrary. However, a bit of investigation reveals that there is some connection after all. The term "kalium" is another word for potassium. Kalium is derived from the word alkali (which itself was derived from the Arabic Al–Qaly). This additional information is helpful because it is clear that scientists chose the letter K for a reason. Once the learners understand that potassium is an alkali element (one of many), it is easier for them to develop a chain of association the letter K and potassium. In fact, the periodic table itself is a tool for organizing elements in a logical manner.

All of this "extra" information assists the learners in retaining the association between potassium and the letter K. It is important to distinguish extra information that enhances learning from extraneous information that inhibits it. For example, telling the learner that bananas are a good source of potassium may be interesting; however, it does not help to make the connection with the letter K, while the information on the word's origin, as mentioned above, could help the learners make a relevant connection.

This structural management strategy, known as elaboration, can assist the learners in making mental connections and thus enhances the meaningfulness and retrievability of the content (Fleming & Levie, 1993). Elaboration is a successful instructional strategy with regard to Facts, because it works in the way that the brain works (Zull, 2002). Elaborating the relationship between components of an association may require some detective work. It also may require some creativity. Spending time generating creative elaborations is often a wise investment.

Mnemonics Unfortunately, this type of elaboration often is not an option. In cases in which the elements of a Fact truly are arbitrary, the designer must attempt to try, artificially, to create meaning. Mnemonics, a method for artificially creating associations to improve the memory, are perhaps the best way to create this meaning. For example, many people confuse the spelling of desert (a dry, arid place) with dessert (a dish served as the last course of a meal). One could remember the difference by remembering the "sweet" one has two sugars (and therefore two s's). In this case, the learner makes a connection between the letter "s" and sweetness of sugar.

Another example, which has even less inherent connection, is recalling the order of colors in the visual spectrum (red, orange, yellow, green, blue, indigo, and violet) by recalling the phrase "Richard of York Gave Battle in Vain." The first letter of each word in this phrase should remind the learner of the relevant colors. The difficulty with using mnemonics, particularly those that have no connection to their referents, is that the learner can forget them easily. The hope is that this connection is sufficient to assist the learners' retention long enough for it to become a part of their repertoire.

Repetition The final structural management technique considered for teaching Facts is repetition. Repetition is a brute force method of learning; but unfortunately, some content is not amenable to other techniques. Not surprisingly, repetition has long been associated with an increase in retention (Thorndike, 1911). Repetition is the core activity of most drill-and-practice strategies, and although drill-and-practice programs are often disparaged, the technique does have an important, if limited role.

Practice Considerations

Practice sequences attempt to remove or fade support for learners. Each type of management strategy has its own unique sequences. Table 8.2 is a sample of how these sequences might be implemented. It should be noted that rarely would all of these sequences be necessary to achieve any particular learning objective.

Table 8.2. Practice Sequences for the Fact Learning Domain.

	Initial	*Intermediate*	*Exit*
Attention management: Modality	Task 1A: Concrete and Familiar: When did Columbus discover America? A. 1492 or B. 1592	Task 1B: Concrete: In what year did a famous explorer "discover" America? A. 1492	Task 1C: Abstract: What famous explorer is said to have "discovered" America and in what year did he do so? A. Columbus, 1492
Cognitive load management: Scope	Columbus discovered America in 149_.	Columbus discovered America in 1_9_.	Columbus discovered America in ____.
Cognitive load management: Learner Action	Recognize: In which year did Columbus discover America? A. 1492 or B. 1592	Edit: Modify the statement below so that it is accurate: Columbus discovered America in 1972.	Produce: What significant event occurred in 1492?
Structural management: Support	Columbus was an Italian living in an age of interna-tional Colonialism, was supported by the monarchs Ferdinand and Isabelle on his voyage. In what year did Columbus make his famous voyage to America?	Columbus was an Italian living in an age of international colonialism. In what year is he said to have "discovered" America?	In what year is Columbus said to have "discovered" America?

Verbatim vs. Paraphrase

One final note on the Fact learning domain: a designer can classify Facts by the type of memorization that they require. Facts can be memorized verbatim (word-for-word) or by paraphrase (the meaning). For example, a learner must memorize, verbatim, an actor's line in a play or the symbol for resistance in an electronic circuit diagram. However, a learner could demonstrate comprehension or the "gist" of a newspaper story by paraphrasing it. No one would expect a learner to recall the story word-for-word.

Additionally, learners may be required to recall a Fact (verbatim of paraphrased) or they may be only required to recognize it. Recognition is an easier task because the learner has contextual signals to assist him. For example, even expert spreadsheet users find it difficult to state under which menu heading the "sort" function (or any other function) is located. However, if asked with the program in front of them, most will have no problem completing a sort task.

If a task does not require recall, it is a waste of time and effort to require the learner to master the task at that level. Similarly, some objectives simply do not require recall. For example, a learner does not need to memorize an infrequently called phone number; the learner can always look it up or store it in device like a cell phone. However, a learner uses and shares his or her own number often enough to justify verbatim recall (it would not do to paraphrase it).

When creating a practice sequence, one should pay particular attention to what type of behavior is required. If complete recall is required, having the learner recognize the proper association may be a helpful strategy to progress to the criterion behavior. However, if recall is not necessary, it may be wiser to establish practice sequences that vary in the amount of cuing provided on the way to recognizing the association without prompts.

Summary

The important ideas in this chapter include:

- The nature of the Facts learning domain.
- The difference between the Fact learning domain and other learning domains.

- The Fact-learning domain requires memorization.
- There are specific strategies to be used in instructional software to teach Facts to learners.

COMING UP: CONCEPTS

In the next chapter, the learning domain Concepts will be examined. Concepts deal with categories or classes of information. And there are unique strategies for presenting and practicing material in Concept domain. Strategies that are appropriate for the Concept domain include distinguishing the figure from the ground, sharing the screen space, demonstrating hierarchies, and providing examples and non-examples.

9

Concepts

Guiding Questions

- What is a Concept and how does it relate to Facts, Principles, and Procedures?
- How do you identify instances of the Concepts learning domain?
- Why are examples important when teaching Concepts?
- Why is the range of a Concept important?
- What strategies are appropriate for presenting content in the Concepts learning domain?
- How do you create practice sequences for the Concept domain?

Chapter Overview

In this chapter, you will learn about teaching concepts. The term "Concepts" has a specific meaning for instructional designers. For instructional designers, the term is not synonymous with an idea or a notion. An idea is a unit of

thought, it is what you are thinking about, while a concept defines a category or class of individuals. Concepts allow you to treat different entities the same. This function is enormously useful. In fact, we would not be able to think without this ability.

A Concept is a classification of entities that share the same features or attributes, such that you can consider them a group. Rand (1990) suggests that Concepts can be defined as "the mental integration of two or more units which are isolated according to a specific characteristic(s) and united by a specific definition" (p. 10). Our ability to regard separate units as members of a class allows us to conserve our cognitive resources, it allows us to make inferences and predictions (Hunt, 1962; Rosch, 1999).

The Nature of Concepts

For example, we have the concept "dog." The "dog" label allows us to identify Great Danes, Beagles, and Poodles as being of the same class. Without the ability to group these separate entities, we would have to treat each as being unique. If we have mastered the Concept of dog, we can muster a set of expectations that allow us to reduce our cognitive efforts. The result is that we can use our limited cognitive resources to deal with aspects of the situation that are truly different. For example, say you come across a large dog rushing toward you in a park. Normally, any large object rushing at you would be cause for concern. However, you have attained the concept of "dog," you have a certain set of expectations. One chain of reasoning that you might have that is associated with the concept of "dog" is that:

IF the entity is a dog, THEN check its tail,

If the tail is wagging, THEN it is likely that the dog is playful/friendly.

With this information, you can then accommodate your behavior appropriately. Perhaps instead of running away in a wild panic, you will assume a more open, yet guarded stance. The information that your conceptualization has provided you has assisted you in selecting your response to the situation.

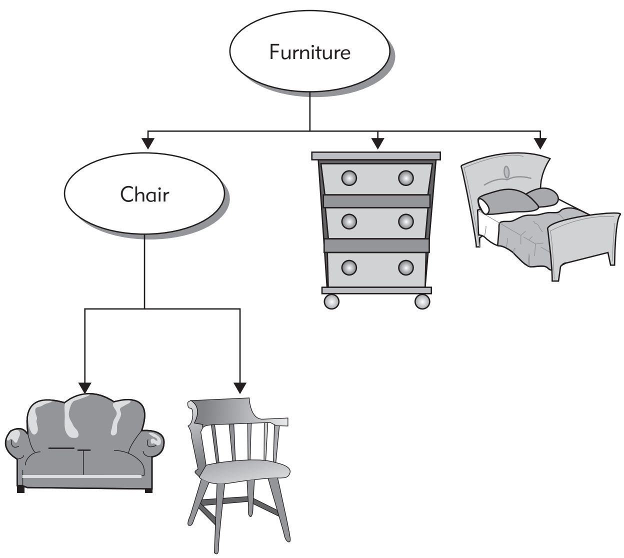
All Concepts are hierarchical in nature. For example, the Concept "furniture" can be broken down into the sub-concepts chair and table. Further,

the sub-concept "chair" can be broken down into the sub-sub-concepts stool and sofa. Figure 9.1 demonstrates this type of conceptual relationship.

The point is that there is always a relationship among Concepts. These relationships manifest themselves in three primary ways: super-ordinate, subordinate, and coordinate. In Figure 9.1 the concepts chair, dresser, and bed are all coordinate to each other, while being subordinate to the concept furniture and while being super-ordinate to the concepts sofa and captain's chair. In this way, it is easy to see that any particular Concept is a "kind of" some other concept (Merrill, 1983). Since Concepts are always related to something else, it is very efficient to learn them. Once you learn a concept, there are an infinite number of instances that you now can recognize as being a member of that category.

These relationships enhance our ability to retain and comprehend instructional material. In fact, one of the best methods of determining whether material is conceptual in nature is to determine whether it can be placed in a hierarchical structure.

Figure 9.1. Conceptual Hierarchy.



Learning Concepts is a matter of distinguishing them from one another. Unfortunately, making this distinction is not easy and requires a number of integrated strategies, including exposure to definitions, attributes, prototypes, examples, and structures. It also must be recognized that assessing concept attainment involves a unique challenge. We must determine whether a learner has mastered the concept by his or her ability to classify and not memorize.

General Strategy

When teaching Concepts, you will have to make a decision as to whether you follow a direct or discovery strategy. The most straightforward method is the direct strategy that requires you to provide the learners with a definition and follow it up with examples. This is called the rule-example strategy and is an example of deduction, which allows the learners to draw conclusions based on the premises (definitions). The reverse strategy is inductive, which consists of reasoning from detailed facts to general principles. The inductive strategy would be to provide the learners with a set of examples and see whether they can produce a definition by recognizing the commonalities. The first strategy is particularly useful for occasions when time is short. The induction strategy is discovery-centric and is more appropriate when time is not an issue and depth of processing is important.

Demonstrating Mastery

Concepts, unlike facts, cannot be merely memorized; they must be understood and comprehended. Understanding and comprehension must be demonstrated for one to be confident that a learner has attained a concept. A demonstration must include a learner correctly classifying examples that have not been previously encountered. Un-encountered examples ensure that that a learner has not merely memorized the association between an instance of a Concept and the Concept's label. It may be tempting to re-use examples in an assessment that were used in the instruction itself; however, that would result in an invalid assessment.

One of the most difficult things about making quality assessment items for concepts is that you have to be sure you are asking the learners to demonstrate

the ability to categorize. For example, the following questions demonstrate both appropriate and inappropriate questions for Concepts:

Appropriate Concept Question

View the following three films: *The Good, The Bad, and the Ugly, A Fist Full of Dollars,* and *High Plains Drifter*. Identify the primary protagonist and antagonist in each film and describe why you have classified each as such.

Inappropriate Concept Question

Who starred in the films *The Good, The Bad, and the Ugly, A Fist Full of Dollars*, and *High Plains Drifter*, and what were the plot lines?

Presentation Strategies

Conceptual presentations can be are taught using three types of strategies: (1) attention management, (2) cognitive load management, and (3) structural management that align with sensory memory, working memory, and long-term memory.

Attention Management

Figure/Ground. To learn a Concept, the learner's attention must be focused on its attributes. Often, attributes are declared as part of a definition. Learners need to be exposed to definitions as a first step in being able to distinguish concepts from one another. A key to a quality definition is to provide the learners with a list of attributes. These attributes should be classified as critical or optional. A critical attribute is one that must be present for an entity to qualify as a concept. Optional attributes are often helpful, but also may lead to misconceptions. For example, if the color red is used as an attribute for the concept "apple," several problems could result. Although, the color red is more often than not associated with apples, it is not the case that all apples are red; green and yellow apples certainly exist. If the color red is treated as a critical attribute, then the Concept will be inappropriately limited in scope and thus limited in usefulness and may ultimately result in a number of misconceptions.

Here's another example. Examine the following definitions of furniture:

- The movable articles in a room or an establishment that make it fit for living or working
- Furnishings that make a room or other area ready for occupancy
- The movable objects, which may support the human body, provide storage, or hold objects on horizontal surfaces above the ground

In each case, moveable, for human use, and horizontal might be considered critical attributes, while size, shape, and color would not be. Neither would be the number of legs. Furniture is often raised off the ground through the use of supports; however, we can conceive of a piece of furniture that does not have this type of support (e.g., beanbags or hammocks).

To teach a Concept, great care has to be taken to ensure that the definitions chosen are as clear and unambiguous as possible. It is also helpful to recognize that dictionaries, the most prominent sources of definitions, rarely claim to be authoritative; rather they attempt to provide a definition based on the historical use of a term. This can be seen most profoundly in the *Oxford English Dictionary* (OED), which provides not only a definition but also the historical context of a term.

The OED's definition of furniture states:

> Movable articles, whether useful or ornamental, in a dwelling-house, place of business, or public building. Context: **1816** *J. SCOTT* Vis. Paris (ed. 5) p. lv, The groups of poor peasants flocking in, with cart-loads of furniture present very distressing spectacles. **1866** *GEO. ELIOT* F. Holt (1868) 10 There was a great deal of dinginess on the walls and furniture of this smaller room.

This context should assist the learner in identifying the range and scope of any concept.

Cognitive Load Management **Highlight goals.** To master learning objectives in the conceptual learning domain, learners must have a clear idea of the requirements that Concepts demand. For example, it is common for learners to memorize a definition and assume that they have mastered a Concept and then, when they are asked to identify an un-encountered instance of the

Concept, they may be unable to do so. To reduce learners' cognitive load, they should be informed of what the conceptual learning domain requires for mastery.

Objectives for the Concept learning domain include action verbs such as categorize, classify, discriminate, generalize, and separate, among others. For example, the following list illustrates conceptual learning objectives:

- The learner will be able to classify, correctly, sample rocks as igneous, sedimentary, or metamorphic.
- The learner will be able to categorize, correctly, a set of governments as being oligarchic, monarchic, or republics.
- The learner will be able to sort, appropriately, paintings in the Impressionistic style from those painted in the Expressionistic.
- The learner will be able to design a house in the Georgian style and have it recognized as such by a panel of architectural experts.

Co-Presentation (Definitions and Attributes). Reducing cognitive load will assist the learners in using their working memory effectively and efficiently. Concepts require the learners to integrate definitions, attributes, and examples together. It may be too much of a burden if they are asked to keep track of these elements mentally. It is far more effective to present these elements on the same screen strategically so the learners can see and refer to them in an instant. For example, if you wanted the learners to be able to distinguish "coffee" from "tea," you would want them to see the definitions and images of both at the same time. Those aspects of the lesson might be presented as in Figure 9.2.

Learning Domain Knowledge. Concepts are described by Facts. For example, the concept "verb" is defined by the statement, "a word showing action, movement, or being." The definition itself is considered a Fact. However, the definition does not exhaustively explain the Concept. The Concept "verb" is completed by a series of examples and non-examples. Concepts are classifiable and relatable to other concepts in a hierarchy.

Just as Facts are elements of a Concept description, so are Concepts elements of Principles. Principles describe how a set of Concepts change and modify one another. For example, the equation of Ohm's law (watts = volts

Figure 9.2. Co-Presentation.

Coffee is a widely consumed beverage prepared from the roasted seeds—commonly referred to as beans—of the coffee plant.

Tea is beverage made by steeping processed leaves, buds, or twigs of the tea bush in hot water for a few minutes.

Images from Yotofoto.com (public domain)

X amps) is a Principle that demonstrates how the Concepts of watts, volts, and amps relate to one another. If the learners have some knowledge of learning domains, they will be better prepared to focus the cognitive resources on the task at hand.

Structural Management **Hierarchies.** Because conceptual knowledge is hierarchical by its nature, one of the most important instructional strategies is to provide the learners with the knowledge of where a Concept exists in relation to others. Every Concept exists within a structure. These structures can be very helpful to the learners in generalizing and discriminating between and among Concepts. The structure is often just as important as the Concept, and the more detailed the structure is, the more likely it is to be retained and retrieved (see Figure 9.1).

Examples and Non-Examples. Unfortunately, because of the limitations of language, even the best definition is rarely sufficient to fully communicate the range and applicability of any Concept. In fact, most dictionaries provide an example of a term to assist in clarifying this ambiguity.

This is particularly important in reference to abstract concepts. Abstract concepts are those that do not have a physical presence. For example, the Concepts justice and democracy must be defined in terms of other Concepts,

each with its own idiosyncratic connotations. In contrast, concrete Concepts are things like furniture, automobiles, and luggage. For example, justice is an abstract Concept. It can be defined as:

> *Justice:* the ideal, morally correct state of things and persons.

To clarify the definition, an example is offered:

> *Justice:* (1) Fair handling; due reward or treatment. Ex. My grandmother gave both my brother and me a basketball for Christmas because she wanted to be fair. (2) The administration and procedure of law. Ex. The defendant, although unpopular, received an attorney to assist him when he made the request.

To further clarify a particular Concept, one needs to provide a series of examples. Examples do the job of showing, while definitions to the job of telling. The two together give the learner a more comprehensive understanding of a Concept. Perhaps the most important instructional principle with regard to learning Concepts is to provide many examples. The more examples, the better the learning experience. It is also critical that the examples selected show the complete range of the Concept. If, for example, you are teaching the Concept of “bird,” you should include examples such as the penguin and the humming bird. These examples demonstrate how widely the concept can be applied.

It is also equally important to show examples that do not qualify for inclusion as a member of the Concept in question. These “non-examples” help the learners appropriately limit the scope of application of the Concept. For example, a bat might be mistaken for a bird because it has several of the characteristics of birds. To explicitly point out to the learners that bats do not qualify as birds will help them make the distinction.

Non-examples help eliminate misconceptions. Misconceptions are a result of learning experiences, particularly of informal learning experiences, that leave the learners with incomplete or inadequate information on what does or does not constitute an example of a Concept. Often, in such cases, the learners are exposed to a narrow range of examples that encourage them to under-generalize the application of the Concept. Experience is often the best teacher; however, it is also the source of superstition and misconception.

Figure 9.3. Concept of a Bird.

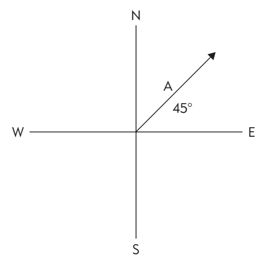
Prototypes. There is evidence to suggest that the brain does not work directly with definitions of Concepts. Instead, the brain constructs a prototype (a standard or typical example) to represent the Concept. The prototype is the "best" example in that it is common and its attributes are easily identified. Providing the learners with a prototype can assist them with constructing their own internal representations. For example, a robin might be used as a prototype for the concept "bird" (Figure 9.3).

The prototype tends to be the most stable representation of a Concept and, in fact, studies have shown that learners can make a connection to an example of a Concept faster if it is closer to the prototypical example. Special care needs to be taken to prevent the learners from "regressing" to the prototype. When this type of regression occurs, the prototype is retained in the mind while the broader examples are lost in memory. To prevent this, you should provide the learners with a broad range of examples shared on multiple contacts over extended period. One of the beneficial things with Flash-based instruction is that it can be revisited at any time and connecting with instruction on a continual basis helps learners' long-term retention.

Practice Considerations

Practice sequences attempt to remove or fade support for the learner. Each type of management strategy has its own unique sequences. Table 9.1

Table 9.1. Practice Sequences for the Concept Learning Domain.

	Initial	*Intermediate*	*Exit*
Attention management: Modality	Task 1A: Concrete and Familiar: Which of the following expresses the idea of a vector quantity? A. The pitcher threw the ball to the catcher. B. The temperature rose to 80 degrees.	Task 1B: Concrete: The scenario below reflects which quantity concept? While driving to the store, Anne traveled a total distance of 4.4 miles. Her trip took eight minutes. What was her average speed? A. Scalar B. Vector	Task 1C: Abstract: Which of the following expresses the idea of a scalar quantity? A. average speed $= \dfrac{\text{distance traveled}}{\text{time traveled}}$ B. $y = 2x + 3$
Cognitive load management: Scope	5 meters is an example of a sc__ar quantity.	The well is 20 meters from the farm house on the right side. This is an example of a V_____ quantity.	A vector quantity has both _____ and ______?
Cognitive load management: Learner Action	Recognize: Which of the following is an example of a vector quantity? A. 20 degrees Celsius B. 5 miles, North	Edit: Modify the statement below so that it is a scalar quantity. The train was running at 35 miles per hour and heading North.	Produce: Make a sentence describing the quantity in this picture. 
Structural management: Support	A vector quantity has both direction and magnitude. For example, a stone dropped off a cliff has a trajectory and a speed. A computer disk has 1 gigabyte of memory. Is this a vector quantity?	A vector quantity has both direction and magnitude. A rocket is shot up into orbit. Is this an example of a vector quantity?	You are told that light travels at 299 792 458 m/s. Is this an example of a vector quantity?

demonstrates a sample of how these sequences might be implemented. It should be noted that rarely would all of these sequences be necessary to achieve any particular learning objective. This table repeats the Concept lesson presented in the Practice Sequences chapter.

Summary

The important ideas in this chapter include:

- This chapter described the Concept learning domain.
- The nature of a Concept and its relation to Facts, Principles, and Procedure are explained.
- The hierarchical nature and relationships of one Concept to another are also clarified.
- Attention management, cognitive load management, and structural management presentation strategies are explored.
- Appropriate practice sequences are examined.

COMING UP: PRINCIPLES

In the next chapter, the learning domain of Principles will be explored. Principles describe how Concepts are related to one another. The components of a Principle will be explained. And finally, presentation and practice strategies appropriate for the Principle domain will be reviewed.

10

Principles

Guiding Questions

- What is a Principle and how does it relate to Facts, Concepts, and Procedures?
- What is the role of causation in teaching Principles?
- What is the difference between a Rule and a Principle?
- How do you identify instances of the Principle learning domain?
- Why are examples important when teaching Principles?
- Why is the range of a Principle important?
- What strategies are appropriate for presenting content in the Principle learning domain?
- How do you create practice sequences for the Principle domain?

Chapter Overview

In this chapter, you will learn about teaching Principles.

A Principle describes how two or more Concepts are related, as well as describes that relationship. Principles are used to answer questions such as, "Why does it happen that . . .?" and "What will happen if . . . ?". Principles are challenging to learn because they require knowledge of Facts, Concepts, and Procedures as prerequisites.

The Nature of Principles

A Principle describes how two or more Concepts are related and provides an explanation for that relationship. You can summarize a Principle with a rule or a set of rules. Rules *describe* a relationship between Concepts, but they do not *explain* that relationship. For example, Einstein used the rule $e = mc^2$ to describe the relationships among the Concepts energy, mass, and speed; however, developing an understanding of the implications of that rule require additional explanation. In other words, mastering a rule is a necessary but not sufficient task in mastering a Principle.

Someone who has mastered a Principle can use its rules as shorthand to describe the essence of a Principle. However, when you are teaching a Principle you must explicitly provide an explanation or a rationale, and not merely state the summarizing rule and assume the learners have fully understood the relationships among Concepts. An explanation makes a rule more comprehensible by describing the causal relationships involved and their implications. The rationale is important because it provides context to assist the learners in generalizing the Principle to new situations.

Rules are necessary components of Principles; however, they are limited because they do not provide the learner with enough information to generalize to unique situations. A rule is a proposition, often in the form of, IF x THEN y, while a Principle needs to be in the form of IF x THEN y, BECAUSE of z. For example, a Rule might be, IF the stop light is red, THEN stop, while a Principle would add, BECAUSE while you are receiving a red signal others are seeing a green signal which, by convention, gives them permission to proceed. If the signals are not followed by appropriate action, then vehicles will not be able to alternate through the intersection,

causing slowdowns and possibly accidents. This explanation provides context for the learners to understand the purpose and function of the Principle.

Rules are easy to understand when they are in the stated as IF–THEN propositions. However, IF–THEN relationships that constitute rules are not always explicit. For example, the statement, "It is important to brush your teeth before you go to bed" is a proposition but not in the IF–THEN format. However, the proposition is clearly implied: IF you have teeth, THEN brush them before you go to bed. Once again, the rule does not rise to the status of a Principle because an explanation is not provided. If the learner understands that brushing one's teeth removes plaque, which prevents tooth decay, then he or she would be closer to mastering the Principle. As a designer, you should remember that all Principles consist of rules, but rules are not equivalent to Principles.

Teaching rules without explanations encourages learners to learn by rote, which results in only surface-level learning. This distinction is important because without an explanation rules may become the source of misconceptions and even superstition. For example, Newton's Third Law of Motion states that, for every action there is an equal and opposite reaction. However, the Third Law is often counter to common experience, such as a bullet exiting a gun barrel. The mass of the gun and of the shooter is so large in comparison to the bullet that the reaction is hidden from plain view. Without an explanation of why this might be the case; without a rationale, a learner is encouraged to merely memorize the rule without connecting it to the learner's larger cognitive structure. A learner should be suspicious of unexplained rules, and designers should make the effort to explain them.

Principles generally demonstrate two types of relationships between concepts: (1) directly causal relationships and (2) probable relationships. A *directly causal* relationship indicates that a change in one Concept will have a knowable and measurable change in another Concept. A *probable* relationship suggests that there may be only a chance that a change in one Concept will result in a change in another Concept and that the magnitude of the change is not known for certain. For example, a description of a molecule describes the relationship between elements with mathematical certainty. However, a description of a management technique is probable because the technique may not be effective in every situation. It should be apparent that, when teaching a learner a Principle that describes probable relationships,

more explanation and context are required to help the learner understand the uncertainty involved in the relationship.

Facts, Concepts, and Procedures are primarily descriptive in nature. They help the learners to define phenomena. Principles, on the other hand, have implications. Learners should always be encouraged to consider the implications of the Principles they are learning. For example, if they are studying Newton's Laws of Motion, they should be encouraged to consider how those laws apply to divergent examples such as feathers and bricks. They should be prompted to ask questions such as, What are the implications of changing Mass in the equation? What are the consequences of changing Force in the equation?

General Strategy

A common direct strategy for teaching Principles is to review Concepts involved and then to simply explain the Principle's rules and provide the learners with a rationale. This is followed by a series of examples that describe the implications of the Principle. Initially, the learners may have to memorize the rule. An explanation will assist the learners in integrating it into their cognitive structure. Once the learners begin to work with applying the Principle, the less they will have to memorize by rote; the rule will be contextualized, making it easier to retain. For example, Exhibit 10.1 demonstrates how an explanation might be presented.

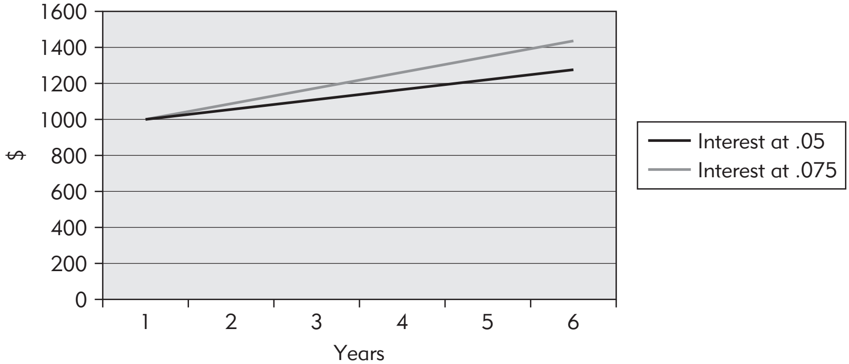
Exhibit 10.1. Explanation of the Future Value of Money.

Future value *measures the nominal future sum of money that a given sum of money is "worth" at a specified time in the future assuming a certain interest rate; this value does not include corrections for inflation or other factors that affect the true value of money in the future.*

For example, what is the future value of 1 money unit in one year, given 10 percent interest? The number of time periods is 1, the discount rate is 0.10, the present value is 1 unit, and the answer is 1.10 units. Note that this does not mean that the holder of 1.00 unit will automatically have 1.10 units in one year, it means that having 1.00 unit now is the equivalent of having 1.10 units in one year.

(http://en.wikipedia.org/wiki/Future_value, 2007).

Figure 10.1. Graph of Future Value of Money Assuming Various Interest Rates.



Another example of a direct strategy is to demonstrate the application of a Principle. For example the graph in Figure 10.1 demonstrates how the Future Value of Money can change based on modifying the Interest Rate.

Discovery

With a discovery strategy, the learners must find and construct the Principle themselves; they must infer the rule and explanation from a series of instances. For example, Exhibit 10.2 demonstrates a question that might be posed to learners. In this example, the learners are provided only a general framework to begin their investigation.

Another example of a discovery strategy would be to provide the learners with a pattern to see whether they can find a mathematical relationship (as demonstrated in Figure 10.2).

Exhibit 10.2. Generative Strategy for Explaining the Future Value of Money.

Your uncle tells you that he invested $10,000 in 1995 and he now has $25,000. How can this be? What interest rate would he have had to have? Can you explain this change in terms of Present Value and Future Value? Can you create a rule that would summarize this relationship? Can you explain the nature of this relationship?

Figure 10.2. Generative Strategy for Explaining the Future Value of Money.

Now	$1,000.00	($1,000.00 × 10% =) **$100.00**	$1,100.00
1	$1,100.00	($1,100.00 × 10% =) **$110.00**	$1,210.00
2	$1,210.00	($1,210.00 × 10% =) **$121.00**	$1,331.00
3	$1,331.00	($1,331.00 × 10% =) **$133.10**	$1,464.10
4	$1,464.10	($1,464.10 × 10% =) **$146.41**	$1,610.51

Can you find a mathematical equation to describe the process involved?

Demonstrating Mastery

Learners can be judged to have mastered a Principle when they can identify the implications of its application to an un-encountered situation. In support of that goal, they should be able to accurately state a Principle's rule and describe its constituent Concepts.

Presentation Strategies

Principle presentations are taught using three types of strategies: (1) attention management, (2) cognitive load management, and (3) structural management. These strategies align with sensory memory, working memory, and long-term memory.

Attention Management

Clarity Like the other learning domains, clarity is of utmost importance when you are designing instructional strategies. The learners must have a clear, unambiguous description of a Principle's rules, rationale, and examples. How each of these components may be presented has been previously discussed; however, an addition that might be considered is to ensure that learners know when they are doing each of these steps. For example, when you are teaching

a series of Principles, each screen should have a similar layout for each piece of the lesson. For example, if you are teaching Concepts, the screen should clearly inform the learners of this task.

Figure/Ground Managing attention while teaching Principles is largely a matter of drawing the learners' focus to different aspects of the constituent Concepts, summarizing rules and rationale. Being able to focus on a particular aspect first requires the learners to be able to distinguish one thing from another. The figure must be separated from the ground. In other words, support must be provided to highlight elements that are being discussed to make it easier for the learners to identify one component from another.

Layout Likewise, when a Rule is being presented, the screen should have a similar interface to previously encountered Rule screens. Compare Exhibit 10.3 with Exhibit 10.5; notice that the same screen layout is used to reinforce the instructional task.

Cognitive Load Management

Highlight Goals Demonstrating mastery of a Principle is a multi-stepped process. To demonstrate mastery, learners must: (1) recognize the constituent concepts, (2) state the underlying rule, (3) comprehend the associated explanation and rationale, (4) identify situations in which the Principle is and is not applicable, (5) appropriately apply the Principle, and (6) evaluate whether or not the principle accomplishes the intended task. Each of these steps highlights a different aspect of the Principle domain of knowledge and you, as a designer, should be prepared to provide instruction for each stage, as well as to provide assessment opportunities that evaluate each aspect.

Learning Domain Knowledge One of the first steps in teaching a Principle is to familiarize the learners with its constituent Concepts. If the learners have not mastered these Concepts, they will not be capable of mastering the Principle.

Exhibit 10.3. Matching Layout.
ordinary annuity = [payment $(1 - (1 + \text{int.rate})^{-(\text{no.periods})})$]/int.rate

For example, if you were to teach the Principle of the Future Value of Money, you would first identify the constituent Concepts. The learners must master the Concepts, Value and Rate of Interest, to understand the rule. For details, on teaching these Concepts, refer to Chapter 9. Exhibit 10.4 describes how the Concept of Value might be introduced.

Once the prerequisite Concepts are understood, the learners can proceed to learning the rule that summarizes a Principle. Although understanding a Principle requires more than being able to state its rule, knowing the rule is an important initial step.

Stating the rule is declarative knowledge (discussed in the Chapter 8). However, knowing the rule is a necessary, just not sufficient, condition for Principle acquisition. For example, Exhibit 10.5 is an equation describing the time value of money.

Exhibit 10.4. Presentation for Concept "Value".

Definition: *Value: the amount (of money or goods or services) that is considered to be a fair equivalent for something else.*

Example: *A plumber values her time at $35 an hour; she is willing to trade an hour of work for $35.*

This is an example of value (in the economic sense) because something (time) is quantitatively appraised in terms of something else (money).

Example: *An element that policy makers must consider when determining whether to reduce carbon emissions or enhance clean water regulations is how much each is valued; they must decide how much carbon emission they would trade for a reduction in mercury levels.*

This is an example of value (in the economic sense) because something (carbon emissions) is quantitatively appraised in terms of something else (mercury levels).

Non-example: *Aunt Sue considered the value of the picture of her grandmother to be priceless; she was not willing to sell it for any price.*

This is not an example of value (in the economic sense) because there is not a quantitative appraisal established.

Exhibit 10.5. Time Value of Money.

$$\textit{Future Value} = \textit{Present Value}\ (1 + \textit{Interest Rate})^{\text{Time Peiod}}$$

Or simply

$$FV = PV\ (1 + i)^n$$

Learners must be able to recall the equation in some situations (What is the equation of the Future Value of Money?) or be able to select it when presented with similar equations (Which of these equations would you use to determine the Future Value of Money?

A) $FV = r_r + I$,

B) $FV = PV(1 + i)^{n,}$

C) $FV = DC/DS$).

Initially, the learners should be presented with a Principle's rule, and in some cases they should be provided a mnemonic to assist them in recalling the rule. However, once the learners begin to work with applying the Principle, the less they will have to memorize by rote. The rule will be contextualized, making it easier to retain, and they will not have to rely on mnemonics.

Co-Presentation Learners must be able to associate the Principle statement (summarizing rule and explanation) with a demonstration of an example; this can be done by displaying both simultaneously on the same screen. By sharing the screen in this manner, you can help conserve the learners' cognitive resources; they do not have to switch back and forth and try to recall what was previously presented.

The learners will have to respond to a Principle statement with an example and, when presented with an example, respond with a Principle statement. The Principle statement acts as cue for the learners and can eventually be faded away and eliminated, as demonstrated in Figure 10.3 and Exhibit 10.6.

Figure 10.3. Screen with Principle Statement and Example.

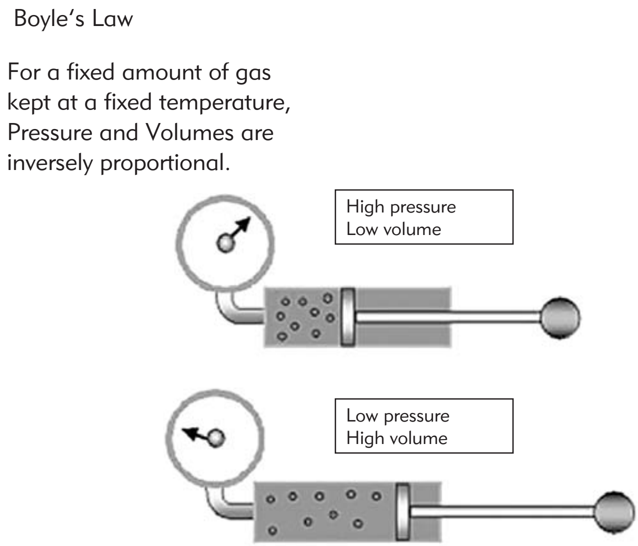


Exhibit 10.6. Principle Statement.
"Boyle's Law: For a fixed amount of gas kept at a fixed temperature, Pressure and Volume are inversely proportional.

Structural Management

You should assist the learners by organizing Principles so that they are compatible with the learners' cognitive structures. By considering how a Principle can fit in with long-term memory, you can assist the learners in consolidating their understanding.

Examples and Non-Examples Enhancing learners' ability to generalize and discriminate the Principle is an act of helping them use it appropriately; it is an act of helping them find the range of the Principle. Learners need to know in what circumstances the Principle can be used and in what circumstances the Principle does not apply. Presenting the learners with examples and

non-examples is critical if the learners are going to develop this type of discernment.

To evaluate learners' ability to apply a Principle, you must provide them with a series of un-encountered examples. Examples must be un-encountered to prevent the learners from demonstrating memorization instead of Principle mastery. To demonstrate complete Principle mastery, the learners must be able to state the summarizing rule, provide a cogent explanation, and use the Principle to predict some phenomena.

Presenting the learners with both example and non-examples of a Principle can help them integrate content into their cognitive structure. For example, the learners may be learning about the Principle of gravity. Even though they may have been introduced to the idea that gravity is a function of the masses of the objects and the distance between them, they may fail to recognize this in practice. They may know that gravity is present on the earth, because they see objects fall to the ground; however, they may see a film of astronauts on the moon and see objects floating and taking longer to land on the surface. As a result of this differential between actions on the earth and those on the moon, the learners may not make the connection that gravity is active on the moon, and is, in fact, active everywhere in the universe.

This misconception is common and can be addressed directly. By sharing a wide range of examples with the learners, the Principle has a better chance of being integrated into the learners' cognitive framework. Learners might also mix up gravity with another source of Force, perhaps Magnetism. By sharing with the learner examples of both gravity and magnetism, they will have a better opportunity to classify them.

Analogy Another strategy is to present the learners with an analogy of the Principle. This allows them to connect the Principle (something unknown) with the analogy (something known). For example, volts in an electrical circuit are often compared to the pressure of water. Figure 10.4 compares the two phenomena.

Finally, it may be helpful to demonstrate to the learners how the Principle can be reorganized or modified. For example, a Principle that can be expressed as an equation can be reorganized algebraically. In the

case of the time value of money equation, because the rule is expressed in a formal equation, it can be manipulated algebraically, as demonstrated in Exhibit 10.7.

This reorganization can maintains the essential relationships within the summarizing rule but may broaden the Principles applicability. The reorganization may also help the learners to connect the material to their cognitive structures.

Exhibit 10.7. Reorganizing Principle Equations.

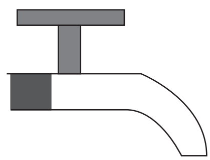
$$FV = PV\,(1 + i)^n$$

is equivalent to:

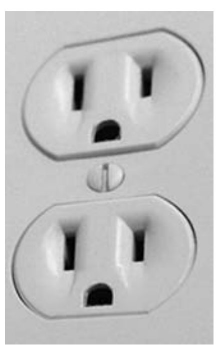
$$PV = FV/(1 + i)^n$$

Figure 10.4. Analogy Between Volts and Water Pressure.

$$\text{Pressure} = \frac{\text{Energy}}{\text{Volume}}$$



Pressure but no flow



$$\text{Voltage} = \frac{\text{Energy}}{\text{Charge}}$$

Voltage but no current

Simulation One of the most powerful types of discovery teaching strategies is to establish a simulation. A simulation allows the learners to manipulate one or more variables and have the consequences demonstrated on the screen. A learner engaged in a simulation is active in both constructing Principles and applying them. Flash is a particularly effective tool for implementing this type of teaching strategy. Simulations allow the learners to apply their knowledge by making decisions and proposing hypothesis; by doing so the learners can get a feel for the implications of their actions.

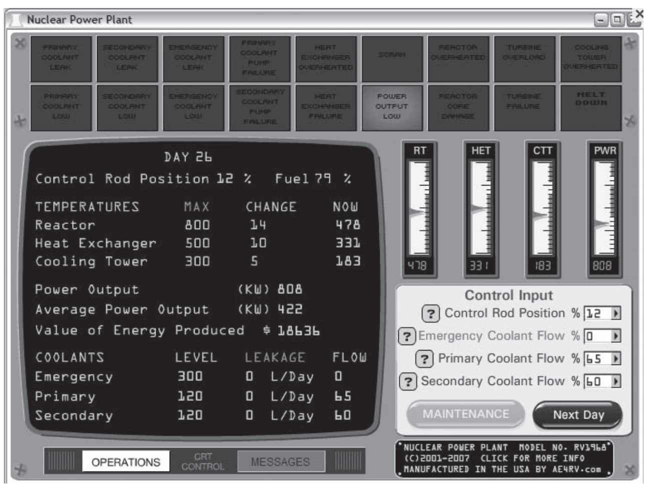
For example, any equation can be used to create a simple simulation. With some simple Flash ActionScript coding, the learners can be permitted to input or select a value for one of the variables. This input can be used to control the graphics on the screen. In this way the learners can make hypotheses and immediately test them out. By doing this, they can construct mental models of how dependent variables relate to independent variables.

Figure 10.5 shows a simulation of a nuclear reactor. The learner can manipulate a number of variables and view the result.

One of the benefits of a simulation is that it helps the learners understand the type of relationships that exist among the Principle's constituent

Figure 10.5. A Nuclear Reactor Simulation.

http://www.ae4rv.com/index.htm. Used with permission.



Concepts. A relationship that is directly causal will respond consistently, while a relationship that is probable will show some variation with the same settings. A probable relationship will have to be programmed with some randomness designed in. For example, a sales training application may be teaching the importance of evaluating potential buyers. The learners could be given a list of attributes of their product's ideal demographic, that is, they are told to identify unmarried, college educated males with an income between $35,000 and $45,000 who work in the financial industry. A simulation could be created with a virtual population the learners could select from. Since sales are probabilistic by nature, the learners could only hope to sell to a prospect a certain percentage of the time. The simulation could be designed so that a prospect selected with this demographic profile would buy 15 percent of the time, while someone who did not fit this profile would only buy 2 percent of the time. In this way, the learners can develop a feel for how prospect and prospecting relate to sales.

Learners using a simulation should be asked, before a simulation begins, to predict not only the type of relationship that the Principle proposes, but the magnitude as well. In the previous example, the learners should be asked, prior to beginning, questions such as, "What is your target population?" "How many sales do you think you can make to this population?" "How much does identifying the appropriate clients mean to your success rate?" "How much of your success is due to luck?" "How much of your success rate is due to your presentation skills?" "How many potential clients do you expect to meet to make a sale?" By having learners create hypotheses first, the simulation can then provide them a forum to test and alter their assumptions. In this manner, the Principle can emerge from the learners' experience with the simulation.

Practice Considerations

Learning presentations are designed to manipulate content to provide support to the learners. Practice sequences have the opposite purpose. Practice sequences attempt to remove or fade support for the learners. Each type of learning strategy has its own unique sequences. Table 10.1 is a sample

Table 10.1. **Practice Sequences for the Principle Learning Domain.**

	Initial	*Intermediate*	*Exit*
Attention management: Modality	Task 1A. Concrete and Familiar: Interest rates are tied to home mortgages. More consumers have been willing to purchase homes when interest rates decrease. What can be predicted if interest rates increase?	Task 1B. Concrete: Interest rates affect home mortgages. What can be predicted if interest rates increase?	Task 1C. Abstract: An increase in interest rates will have what effect on the following products?
Cognitive load management: Scope	In the equation below, what constant represents the interest rate [$P = C(1 + r/n)^{nt}$]	In the equation below which quantity represents the interest rate? [$P = X1(1 + x2/n)^{nt}$]	In the equation below which quantity represents the interest rate? [$X1 = X2(1 + X3/X4)^{nt}$]
Cognitive load management: Learner Action	Recognize: Which of the following equations describes how interest is compounded?	Edit: Modify the equation below so it is appropriate to for compound interest.	Produce: Describe the effects of a change in interest rates on the future value of an investment.
Structural management: Support	Compound interest can be described by the equation: $P = C(1 + r/n)^{nt}$ where P = future value, C = initial deposit, r = interest rate, n = # of times per year interest in compounded, t = number of years invested. What are the affects of a change in interest rate on future value?	Compound interest can be described by the equation: $P = C(1 + r/n)^{nt.}$ What are the affects of a change in interest rates of future value.	Interest rates move from.06 to .09. What are the affects on future value?

of how these sequences might be implemented. It should be noted that rarely would all of these sequences be necessary to achieve any particular learning objective.

Summary

The important ideas in this chapter include:

- The differences between principles and rules are explained.
- The importance of learners having an understanding of concepts and rules in understanding principles was also discussed.
- The chapter concludes by presenting key instructional strategies for teaching principles to learners.

COMING UP: PROCEDURES

The next chapter, Procedures, is the last chapter on the learning domains. The chapter discusses the difference between heuristic and algorithmic procedures. The chapter also discusses how presentation strategies and practice sequences can enhance learning in the procedural learning domain.

11

Procedures

Guiding Questions

- What is a Procedure and how does it relate to Facts, Concepts, and Principles?
- What is the difference between a heuristic and an algorithm?
- How can you use the idea of chaining to teach Principles?
- How do you identify instances of the Principle learning domain?
- How do job aids and Procedures relate?
- Why are examples important when teaching Procedures?
- What is the role of Principles when teaching Procedures?
- What strategies are appropriate for presenting content in the Procedure learning domain?
- How do you create practice sequences for the Procedure learning domain?

Chapter Overview

In this chapter, you will learn about teaching Procedures, a series of steps, performed in order under specific conditions. Underlying each Procedure is a set of rationales and principles. Procedures are primarily concerned with preparing the learners to "do things" and to take action.

The Nature of Procedures

A Procedure is a series of steps intended to achieve a specific outcome. Procedures can be algorithmic or heuristic in nature. An algorithmic Procedure is one that, when followed, will always produce the same result. A heuristic, on the other hand, is similar to an algorithm except that it can be applied in a number of ways; consider it more a "rule of thumb." A heuristic is more of a suggestion, while and algorithm is well defined and has a specific and finite set of steps to follow.

An example of an algorithm is a computer program. The computer has to follow a software program exactly; there is no opportunity for modifying the instructions. If there is a flaw in the algorithm, the computer program will fail to function. Practicing medicine is an example of a heuristic-based activity; if a patient has a headache, a physician might prescribe an aspirin; however, there are no guarantees that the medicine will work. The aspirin is likely to help, but will not always help. The physician could also have tried ibuprofen or deep-breathing exercises.

Procedures can be placed on a continuum between pure algorithmic and pure heuristic. When you analyze a Procedure, you must determine in which category it belongs because the choice you make will lead to different instructional interventions. For example, suppose your objective is to teach someone to make chocolate chip cookies. If you classified the Procedure as an algorithm, you would want to stress the importance of following the recipe exactly; you would ensure that the learners were very strict in their measurements and that they were careful not to skip any steps. If you classified the Procedure as a heuristic, you would want them to have a better understanding of the underlying Principles that guide the task. For example, you might want them to know that baking soda can act as a leavener (it gives

off carbon dioxide when mixed with an acid, and this causes the food to expand). Armed with this knowledge, the learners would be better prepared to decide, if they realized that they do not have baking soda, whether to continue with the rest of the recipe. An algorithm is more useful in a specific case, while a heuristic is more helpful in new, un-encountered situations.

Most Procedures you will encounter in educational settings are, at least to some degree, heuristic ones. This is fortunate because what heuristics lose in certainty they gain in generalizability, and because the world we encounter is one in which change is common, we have a better chance of dealing with the world with heuristics. The downside is that heuristics require the learners to know more and think more, which makes your job as an instructional designer more involved.

Some Procedures are serial, where each step follows the previous one in a consecutive series. Serial Procedures do not require the learner to make decisions, nor do they require data from the environment to function; other Procedures branch, meaning that the learner is required to make decisions at certain points. For example, the Procedure for opening a door is dependent on its current state (locked or unlocked). If the door is unlocked, then learners merely have to twist the doorknob. If learners encounter a locked door, they must select an appropriate key, unlock the door, and only then may they twist the doorknob to open it.

Connect with Task Analysis

Documenting a Procedure is unique among the learning domains in that its source is observable; you as a designer can see actions taking place (or can hear an account of them if they are primarily cognitively covert in nature). The other learning domains are the result of logical inferences made outside the engagement of any particular task. Teaching Procedures begins with a specific type of task analysis called behavioral analysis or information processing analysis.

The first thing to focus on when teaching a Procedure is the accuracy and completeness of your description of the Procedure. You must document a procedure from a source. This documentation is done while completing a task analysis (see Chapter 2 on Planning for more details on task analysis).

Generally, you analyze a procedural task by observing and interviewing a set of expert performers.

You must then use the information taken from experts and create a series of steps that not only describe the performance but also provide appropriate context for a novice.

A typical procedural analysis is illustrated in Table 11.1.

Jonassen, Tessmer, and Hannum (1999) suggest creating a grid (Table 11.2) to organize the procedural analysis.

Table 11.2 demonstrates the task of performing the Heimlich maneuver, which is useful in rescuing someone from choking (wikiHow, 2007).

The result of a procedural task analysis is a step-by-step guide. You will present this guide to the learners in various formats in instructional presentations and practice sequences. You must adjust and augment the steps to account for the learners' prior knowledge and to provide them with learning domain information that will assist them in generalizing the procedure.

Table 11.1. Procedural Analysis.

	Steps	*Rationale*
1.	Identify the criterion objective of the task.	What are the goals?
		What needs to be done?
		What needs to be accomplished?
2.	Choose task expert(s).	Experts are the primary source of knowledge from conducting a procedural analysis. Designers must be careful because often experts are too fluent in the Procedure, meaning that they may skip steps or may not even be aware of the steps involved, even though they can perform them. They may have internalized the Procedure to such a degree that they no longer have verbal access to it.

3.	Document the Procedure in grid form.	A grid is important because it provides an easy framework to organize knowledge. It reminds you of important question to ask. When documenting a Procedure, it helpful to work with several experts because often they will have idiosyncratic methods of accomplishing the task. It also should be noted that experts are not without misconceptions.
3A.	If the task is overt, then observe the experts.	Any task that requires a performance can be observed. Often it is helpful to record the event with a video camera so the event can be analyzed in detail.
3B.	If the task is covert, then interview the experts	Many Procedures involve only cognitive operations or a combination of overt and cover behaviors. To ensure that you understand what an expert is doing and to understand their rationale for doing, so you must ask them to report what they are doing at each stage.
4.	Review documentation with experts.	It is often helpful, to review the expert's performance on video to gain the expert's commentary. Once a draft of the Procedure is created, have your experts review it for clarity and for comprehensiveness.
5.	Edit documentation with learners in mind.	At this point, you may need to chunk the steps into logical units that reduce the learners' cognitive load. This may also help the learners recall the steps if they are organized in a logical and meaningful manner.
6.	Produce a flow chart.	Many learners find flow charts useful because they provide a graphical display that demonstrates the relationships of different steps all at once. The symbols used in a flow chart can remind the learners of the actions that need to be taken.

Table 11.2. Organized Procedural Analysis.

Step #	*Operation*	*Result*	*Decision*	*If*	*Else*	*Notes*
1.	Initiate procedure.	Begin.	Determine whether a person is a choking victim.	If victim has his or her hands around throat and panicked look on his or her face.	Assist with less invasive means.	Only use this procedure is it is clear that no air is getting to the lungs. If the person is choking he or she will not be able to verbally consent to the procedure.
2.	Get the victim into a standing position.	Victim is standing.				
3.	Get behind the victim.	You are behind the victim.				Stand with your legs separated, your right leg slightly between the victim's, your left leg slightly behind you, to form a "tripod" in the event that he or she faints or becomes unconscious.
4.	Position your hands.	Your hands are in the proper position.				Reach around the victim from behind and make a fist near, but just above his or her navel with your left hand, and wrap your right hand around this fist, firmly against the victim's abdomen.
5.	Thrust.	Food is dislodged.	Should the learner repeat the procedure?	If food is dislodged, stop.	Else continue thrusts.	In a lifting motion, pull up with both hands sharply into the solar plexus (above the navel, but just below the midsection of the ribs), as if you are trying to jerk the person off his or her feet from this position.

General Strategy

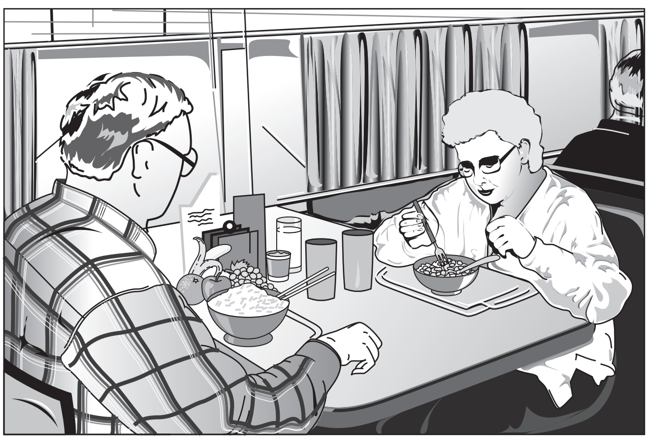
You can teach Procedures with two primary methods, directly or by discovery. Using the discovery method, you would ask the learners to create a Procedure while watching a performance. With this strategy, the learners take on many of the roles as the designer; they observe, analyze, and question to build documentation of the Procedure. This can be an effective method, but it can be time-consuming.

Another discovery strategy would be for the learners to practice applying the procedure by making decisions in a simulation. For example, you could provide the learners with a staged problem scenario. Figure 11.1 shows a screen that presents a problem to the learners and asks them to make a decision.

This screen would then change to inform the learners of the results of their decisions and provide them some feedback on whether they made correct choices. Figure 11.2 demonstrates this response.

The other general method available is the direct approach, which requires you to present the Procedure to the learners. The direct approach, in general,

Figure 11.1. Procedural Simulation Decision Point.



You overhear the gentleman sitting next to you at Al's diner say to his wife, "I think I am choking." Would it be appropriate to apply the Heimlich maneuver?

Yes No

Figure 11.2. Procedural Simulation Decision Feedback.

You responded that, yes, you should begin performing the Heimlich maneuver. Unfortunately, that is premature in this case. As long as the victim can speak, air is getting to his or her lungs, and thus the Heimlich is not required.

takes less time than the discovery strategy. A quality direct instructional sequence can be very effective, although it may not provide as in-depth an experience as a discovery strategy.

Demonstrating Mastery

Mastering a Procedure involves being able to (1) select the appropriate Procedure for a particular circumstance, (2) state the steps involved, (3) apply the Procedure, and (4) confirm that the task was accomplished. You should explicitly address each of these skills, in both presentation and practice, for the learners to achieve mastery. Too often, the learners learn to state the steps and the designer assumes that they have mastered the entire Procedure.

The first goal is to prepare the learners to match Procedures with circumstances. For example, a learner faced with the task of opening a bottle of wine must recognize that the situation calls for an uncorking Procedure. Learners must be able to choose this Procedure from other similar, but inappropriate, Procedures such as opening a bottle of soda or opening a milk carton. Further, there are multiple types of wine corks (traditional cork and

plastic twist) that require different Procedures, so the task has to be discriminated another step. Each of these tasks is an example of opening a container of liquid. However, the steps involved are quite different.

Once the learner selects the appropriate procedure, the learner must be able to state the steps required to transform the situation. In general, opening a bottle of wine requires (1) holding the bottle in a fixed, upright position, (2) removing the bottle wrapping, (3) inserting the corkscrew, and (4) pulling down the corkscrew's leveraging arms. Without knowledge of these steps (which may involve further details and decision points), the learner will be unable to continue.

Unfortunately, it is not sufficient for learners to be able to recall the steps of a Procedure. They must be able to apply those steps to tasks. More often than not, there is a wide difference between knowing how to do something and actually being able to do it. This is a major problem with training instructional experiences; too often designers do not ask the learners to perform tasks. For example, will uncorking a bottle of wine will require the learners to judge what it means to "hold" the bottle? If they choose to hold it carefully like an egg, they won't be able to establish a firm foundation; if they grip it like a vice, they may break the bottle. Experience in applying the Procedure provides a learner with valuable feedback that fills in the blanks left by a verbal description.

The process of learning Procedures can greatly benefit from practice sequences and simulations developed in Flash. While any simulation is limited, they often can provide an experience that generates some of the feedback that direct experience would provide. Ideally, you want the learners doing things instead of merely answering questions about things.

Finally, the learners will have to make judgments as to whether the Procedure selected was able to fulfill the task. For example, a cork that was only partially removed has the potential to contribute to a spill if the wine comes rushing out as the cork's grip slips. Learners need to be able to determine whether the task was accomplished and, if not, what occurred to prevent successful completion.

In addition to these performances, the learners must be able to apply the Procedure to a number of separate un-encountered situations. Successfully

resolving an un-encountered situation through the application of a Procedure is necessary to provide evidence that a learner has mastered the Procedure instead of merely memorizing the steps. Mastery involves comprehending, understanding, and applying Procedures, and the only way to judge whether learners have acquired these abilities is to have them address un-encountered problems.

Judging mastery of a Procedure requires you ask the learners to demonstrate that they can not only describe the steps involved in the Procedure but can apply those steps to un-encountered situations. Just as when teaching concepts, you want the learners to demonstrate the implementation of the Procedure in a manner that is not dependent on memorization. You must ask the learners to perform in an un-encountered situation to ensure that they have mastered the procedure and not merely memorized it.

Presentation Strategies

Procedure presentations are taught using three types of strategies: (1) attention management, (2) cognitive load management, and (3) structural management that align with sensory memory, working memory, and long-term memory.

Attention Management

Clarity Perhaps the most important factor in focusing the learners' attention is to be as clear as possible. Learners can easily be confused by an explanation that is not clearly communicated. It is important that explanations be to the point and easily understood. It is also important that any text used be formatted in such a way as to increase legibility. For example, narrow columns are easier to read than wide columns because it is easier for the eye to pick up the next line when the distance it needs to travel across the screen is reduced. It is also easier to read some fonts and point sizes on the screen. You should experiment to determine what works best to improve the clarity of your presentations.

Figure/Ground Procedures ultimately need to be conducted in context. For example, choking might occur in public at a restaurant or in a private residence. The restaurant might have hundreds of patrons, waiters, and other distractions. Learners need to be able to apply the Heimlich maneuver Procedure in any

of these environments. To assist the learners in focusing on a victim who is choking, you must bring attention to the Figure (victim) and subdue the Ground (the rest of the restaurant). A video could be used that uses sounds that are only relevant to the task at hand. Or a camera could focus narrowly on just a few tables instead of the restaurant as a whole. These devices can help focus the learners' attention.

Layout Instruction of a Procedure is likely to require many screens, particularly if the Procedure is long or complicated. As much as possible, the interface on each successive screen should be laid out in a similar manner to assist the learners in navigating the application. If the interface changes from screen to screen, the learners will have their attention diffused as the attempt to reorient themselves to each change. Navigation buttons, content boxes, and headings should all be placed on each screen in exactly the same positions.

Demonstration Procedures are particularly amenable to demonstrations. Procedures are unique among the learning domains because they describe phenomena over time. Procedures consist of a series of steps that occur one after the other (not necessarily linearly). To draw the learners' attention a demonstration is often helpful. Some Procedures require an extended period to be implemented, while others are completed in a time frame that cannot be observed. A planned demonstration can condense time or expand it assist the learners in focusing on the steps. Technologies such as video and animation are particularly useful for this purpose. For example, a real-life choking emergency unfolds in a matter of seconds—too fast for learners to attend to all the relevant details. By slowing time, a Procedure for assisting the victim can be demonstrated at a pace that is comprehensible to a novice.

Cognitive Load Management

Highlight Goals How many of these sub-objectives and skills are examined is dependent on how widely you want the learners to apply the Procedure. For example, if your objective is simply to have the learners be able to assist someone at a restaurant in an idealized situation, they may be able to do so if they have memorized the steps. However, most cases are not ideal, and a number of factors may require learners to slightly alter the Procedure.

For example, if the victim is taller or larger than the average person, the maneuver will have to be altered slightly. The more knowledgeable the learners are about the principles underlying the maneuver, the easier it will be for them to modify it and reach the intended goal (saving the victim). Likewise, if a doctor and has been told that a patient in the emergency room has just been rescued from choking by someone using the Heimlich maneuver, he or she would want to know, in detail, all of the associated details around the technique. This background knowledge might encourage them to check for damage to the esophagus and sternum, for example.

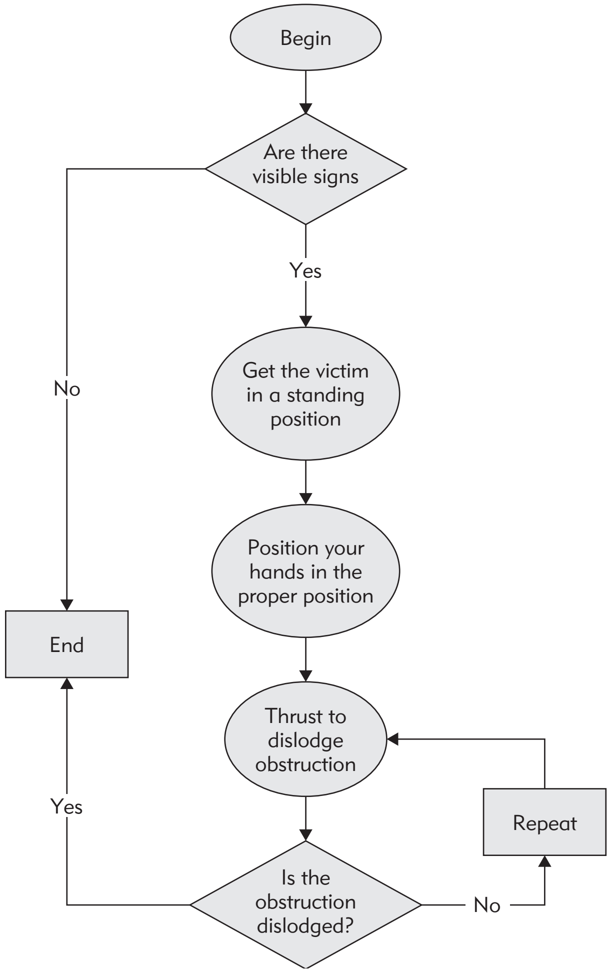
Flow Chart Once you have documented a Procedure in a format such as Table 11.2, you can reorganize that material into a flow chart. A flow chart conveys procedural steps, graphically, which can be easier to follow than information in table form. Flow charts also highlight important decision points, which remind the learners when they have to evaluate the situation and act. A typical flow chart is demonstrated in Figure 11.3.

In a flow chart, each segment of information is a node. Links connect the nodes together. To demonstrate a step in Flash, you can change the color of the nodes to focus the learners' attention, or you can display only one node at a time. This ability to manipulate the presentation of nodes can reduce the number of elements that learners must remember as they connect the individual steps to the larger task.

Co-Presentation Additionally, it can be helpful to the learners to present a flow chart in split screen mode. For example, you can place the flow chart on one side of the screen while placing the corresponding task on the other side, as in Figure 11.4.

Learning Domain Knowledge Each learning domain has its own unique set of requirements for mastery. Alerting the learners to an objective's learning domain can help them orient themselves to the learning task. In any procedure, you need to teach the learners what the steps are, as well as their rationale. Knowing the rationale is what leads to generalizing the Procedure. The steps themselves belong in the Fact domain; the learners has to memorize them, while the rationale usually consists of combinations of Concepts and

Figure 11.3. Flow Chart.



Principles. Identifying the relevant Concepts and Principles and encouraging the learners to comprehend their relationship is a key instructional task.

For example, in the Heimlich maneuver Procedure in Table 11.1, it may benefit the learners to know the following facts: anatomy, the concepts: consent, gas, mass acceleration, and the Principles: oxygen deprivation, air pressure, cavity pressure, force, and muscle contraction. All of these elements contribute to a full knowledge and understanding of the Procedure. It should

Figure 11.4 Flow Chart/Demonstration, Split Screen.

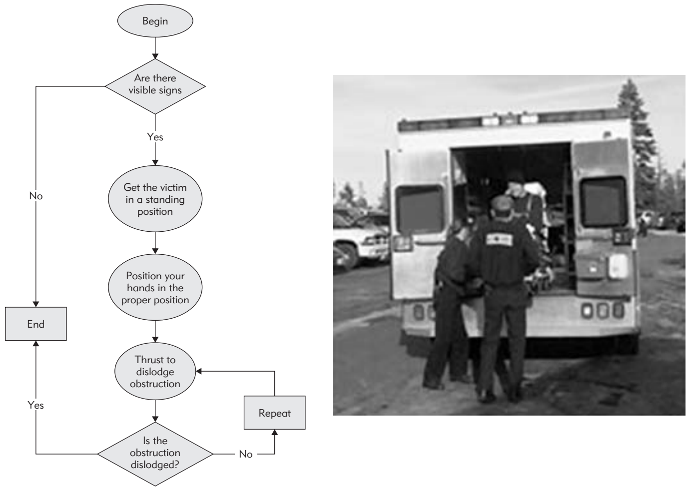


Image from Yotofoto.com

be apparent that, even in this simple example, a Procedure might involve a large, perhaps overwhelming number of potentially useful sub-objectives.

Unit Size Procedures can be long and complex. The number of constituent steps can quickly overload learners' cognitive capacity. The easiest method of assisting the learners in managing and maximizing their cognitive capacity is to break the Procedure down into smaller sets of steps. If there are more than seven steps, you should consider consolidating them or selecting only a few to teach at any one time.

To shorten the path through a Procedure, you can replace a series of steps with a single step stated in general terms. For example, in the flow chart in Figure 11.3, the third node states, "Get the victim on his or her feet." This step assumes that the learner has either mastered the sub-components of this step or that those steps are obvious for the average user. However, it may be the case that you teach this step to mastery later. Standing someone up may not be a trivial task; the victim may resist, may be too large to move, or may be unable to provide assistance. If you are going to consolidate a series of steps, be sure that the learners have another opportunity to master a step's sub-components.

It is even more helpful if you can organize these steps into categories that relate to Principles. For example, the Procedure for the Heimlich maneuver is a subset of a larger Procedure for delivering first aid. The larger first aid Procedure may be as described below.

First Aid Procedure

Step 1: If there appears to be an emergency, call 911.

Step2: Remain calm.

Step 3: Make sure you and the injured person are not in danger.

Step 4: Assess situation.

Step 5a: IF: emergency pertains to one of the following options, begin implementing appropriate response.

- Unconsciousness
- Bleeding
- Burns
- Broken bones
- Choking
- Shock

Step 5b: ELSE: Observe injured person's condition until emergency personnel are available to assist.

In this manner, you can teach each smaller set of Procedures separately and then integrate them into a more comprehensive Procedure. This method makes the Procedure more manageable and encourages mastery.

Side note: Software such as Adobe Captivate can be of great assistance when teaching procedures. Adobe describes Captivate as having the ability to "create powerful and engaging simulations, scenario-based training, and robust quizzes without programming knowledge or multimedia skills." However, it is most powerful when you use it to document a Procedure produced on the screen. If your Procedures involve demonstrating how to use software or similar activities, I encourage you to explore using Captivate or similar tools such as Camtasia.

Structural Management

Optimal Path One the most effective methods for teaching Procedures is to identify an optimal path through the Procedure for each learner. If you present an overly detailed Procedure to a learner who has already mastered many of the steps, he or she may become bored, which will interfere with the ability to assimilate the material. In the same way, if the steps are not sufficiently detailed, the learner may become lost and not have a context for integrating the material.

One method for identifying the ideal starting path through a Procedure is to begin with a simplest path and see how each learner performs. If a learner cannot perform the Procedure successfully, he or she should be presented with a more detailed path. This requires that a number of separate presentations be created documenting the Procedure. As a designer, you will have to make a cost/benefit decision as to how many paths to construct (which take time and resources to conduct) and compare those costs with the benefits of the instruction (how many learners there are and how important mastering the objectives is).

Analogy Another useful method for assisting the learners in mastering a Procedure is to provide them with an analogy. An analogy draws a comparison between two different subjects to demonstrate a similarity. For example, one might suggest that a glove relates to a hand in a way similar to the way that a sock relates to a foot; there are differences between these two objects, yet, the similarities should help the learners consolidate their understanding and connect it with the cognitive structure. Having the learners work with the analogy may further assist their comprehension. For example, in the above analogy, they may suggest that, while there are similarities between a sock and glove, a stronger similarity might be between a sock and a mitten.

In the case of Procedures, an analogy can be more difficult to make because we are not talking about a single thing but a set of steps. For example, Richland, Holyoak, and Stigler (2004) presented this decontextualized math problem: "It is divided by negative 60, so we multiply by negative 60 on both sides." They then created an analogy outside of math for comparison. The analogy states, "It's like balancing a scale. Matter doesn't disappear,

so to keep it balanced, whatever we do to undo one side we have to do to the other" (p. 44).

As mentioned before, learning Procedures is not merely about recognizing their constituent steps. It is also necessary that the learners understand the rationale and principles involved. A rationale is an explanation for performing a task; it is the logical basis of a Procedure. Without such an explanation, the learners will have difficulty placing it in their cognitive structures; without a rationale a Procedure is arbitrary and has more in common with trying to remember a random number sequence than it has with comprehending it so that it can be applied to a wide variety or un-encountered situations.

For example, the algebra procedure introduced above is a single instance of the Property of Equality, which relates concepts such as addition, multiplication, and division to concepts such as constants and variables. Another example, the principle behind the Heimlich maneuver, is that air pressure increases as the available space in the lungs decreases, exerting pressure on any object lodged. Similarly, the principle behind CPR is that blood circulates from the muscular compression of the heart's chambers.

Examples A procedure may be appropriate for some circumstances, and it may be inappropriate for others. Encouraging the learners to become skilled at determining how widely they can apply a particular Procedure is important. Likewise, assisting the learners in determining which situations the Procedure is not appropriate for is important. One of the best methods for developing this skill within learners is to present them with a series of examples.

Choose examples based on their divergence from the prototypical situation. For example, the Heimlich maneuver could be demonstrated on an average-sized adult, and then the demonstration could be repeated on a plus-sized adult, and finally on a child. A wide range of examples will allow learners to understand which elements of the Procedure are universal (applicable to any situation), such as confirming that a victim is choking, and which elements are situational (the exact hand position varies depending on the size of the victim). Examples also demonstrate what elements a learner might modify to be appropriate for different situations. For example, the force of a

thrust applied to a child might initially be less powerful than that used on an adult, or one might adjust one's grip when assisting a larger person to gain proper leverage.

It also might be useful to have examples of the Procedure in different environmental contexts. For example, a prototypical demonstration of someone needing assistance for choking may take place in a restaurant; however, the learners may have to apply the Procedure at a work site or on an airplane, where the mental connection to an airway obstruction may not be as strong.

It is equally important to share with the learners non-examples. Non-examples are situations in which learners may commonly misapply the Procedure. These situations seem similar and it looks like a particular Procedure could be successfully applied; however, on closer inspection, another Procedure is more appropriate. For example, if you were confronted with a choking infant, it would be inappropriate to apply the Heimlich maneuver without modification. In this situation, there is another Procedure one should use, designed specifically for infants. By exposing the learners to this type of non-example, possible misconceptions are addressed directly.

Practice Considerations

Practice Sequences

The sequences in Table 11.3 are examples of how practice might be developed for the procedural domain to strategically remove support for the learners.

Summary

The important ideas in this chapter include:

- This chapter explains Procedures and how they relate to Facts, Concepts, and Principles.
- Two main kinds of Procedures are discussed here: algorithmic and heuristic.
- The features of each Procedure, along with the different learning outcomes associated with each approach, are also highlighted.
- Presentation strategies and practice sequences are discussed.

Table 11.3. Practice Sequences.

	Initial	*Intermediate*	*Exit*
Attention management: Modality	Task 1A. Concrete and Familiar: In which of the following scenarios would it be appropriate to apply the Heimlich maneuver? A. Video demonstration A. B. Video demonstration B	Task 1A. Concrete and Familiar: In which of the following scenarios would it be appropriate to apply the Heimlich maneuver? A. Your dinner companion is coughing and says, "I think I am choking" B. The person at the table next to yours has suddenly turned red and has a panicked look on her face, she is clutching her throat.	Task 1C. Abstract: A person who is choking requires assistance with the Heimlich maneuver. A sign that the person is not choking is: A. He can still breathe. B. He turns red.
Cognitive load management: Scope	The first step to applying the Heimlich maneuver is to determine whether the victim is choking; the next step is to___, and the third step is to position your hands properly.	The Heimlich maneuver has four components. The second component is . . .	Describe the components of the Heimlich maneuver.
Cognitive load management: Learner Action	Recognize: Which of the following is the correct procedure for applying the Heimlich maneuver.	Edit: Modify the procedure below so that only the essential components of the Heimlich procedure remain.	Produce: Describe the steps involved in implementing the Heimlich maneuver.
Structural management: Support	The Heimlich maneuver was created by Henry Heimlich to assist victims of choking. Which procedure below is an illustration of the Heimlich maneuver?	The diagram below demonstrates a technique to assist victims of choking. Which component is incorrect?	What procedure should be conducted on the victim in Diagram A?

COMING UP: CASE STUDY

In the next chapter, a case study is used to demonstrate how specific objectives from each of the learning domains discussed in this book are reviewed. The case study uses supply-and-demand economic theory to demonstrate how a variety of instructional techniques can be implemented with the tools demonstrated in the Flash guides. An explanation is provided, along with references to the relevant Flash tools.

12

Case Study

Guiding Questions

- How can design principles and Flash techniques be integrated and synthesized in an instructional application?
- Why is one technique chosen to fit the needs of the learning objectives?

Chapter Overview

This chapter illustrates how many of the techniques presented in the Flash guides can be applied to solve instructional challenges. The content follows from the design that was begun in the Chapter 2, which ended with the development of objectives and test items.

Implementation Model

Once learning objectives have been established and those objectives have been assigned to a learning domain, then appropriate strategies can be selected. Table 12.1 summarizes the strategies that have been introduced in this text.

The strategies in Table 12.1 are divided into three types (attention management, cognitive load management, and structural management). Recall that these types align with sensory, working, and long-term memory systems. By selecting strategies that target each primary memory system, learning should be enhanced.

Table 12.1. Summary of Instructional Strategies.

	Attention Management	*Cognitive Load Management*	*Structural Management*
Facts	Clarity/ Figure/ground separation/Layout	Learning domain knowledge/Highlight goals/ Graphic organizer (table)/ Unit size	Elaboration/ Mnemonics/Repetition
Concepts	Clarity/ Figure/ground separation/Layout	Learning domain knowledge/Highlight goals/ Co-presentation (definitions and attributes)	Hierarchies/Examples and non-examples/ Prototypes
Principles	Clarity/ Figure/ground separation/Layout	Learning domain knowledge/Highlight goals/ Co-presentation (rule, explanation, and example)	Simulation/Analogy/ Examples and non-examples
Procedures	Clarity/ Figure/ground separation/Layout/ Demonstration	Learning domain knowledge/ Highlight goals/Flow chart/ Co-presentation (flow chart and example)/Unit size	Optimal path/Analogy/ Examples
Practice Sequences	Modality	Scope/Learner actions	Support

The Tasks section is meant to provide you with some ideas. You may want to refer back to the specific Flash guides to understand how to implement a Flash technique.

In the section below each of the objectives is addressed in detail, to demonstrate instructional strategies from each learning domain. These examples are primarily for the purpose of demonstration. Rarely, if ever, will any one particular objective require the application of all of these strategies; doing so could easily be considered overkill.

You should select the objectives that you believe to be the most critical and the ones on which learners have the most difficulty. It is important to implement strategies in number and in scope that allow the learners to master the objective in the most efficient manner possible. You should strive to provide the learners with no less than they need and no more then is helpful.

User tests are particularly important (discussed in Chapter 14) because they can give you a good feel as to whether you have provided a sufficient number of presentations and practice sequences to help the majority of your learners learn.

Objective 1 (Facts). Given a supply and demand graph, you will be able to identify and appropriately label the parts of a supply and demand graph including price, quantity, equilibrium point, supply curve and demand curve. You will be able to accomplish this task seventy-five percent of the time.

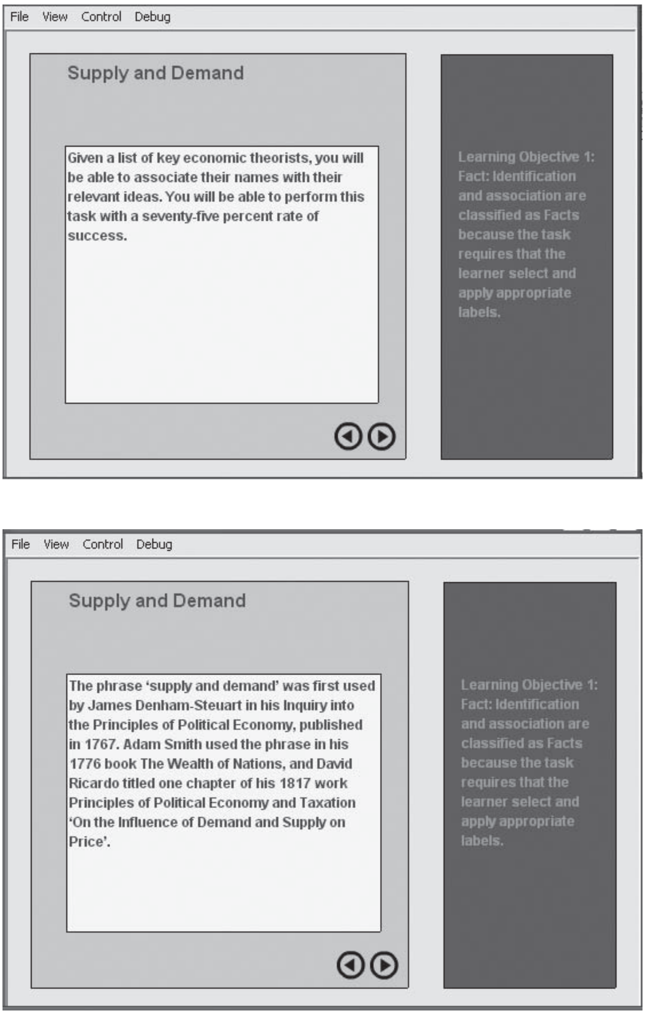
Possible Presentation Strategies

Attention Management

Clarity. Enhancing clarity in the instructional materials is critical. To achieve this objective, a text description should be provided to the learners. For example, the text should address why it is important for the learners to master the parts of a supply-and-demand graph. The text should also describe why this type of graph is useful, as well as provide some background information for context. This text description should use clear and easily understandable language appropriate for the target audience. The Flash guides Static Text,

Dynamic Text, and Working with Variables all provide useful methods for implementing any sort of text communication with the learners. Static text is useful when content requires unique formatting (e.g., font, font size, bold, etc.) but does not have to be updated or edited often. Dynamic text allows you to assign text to a variable and be automatically assigned to an area on the screen; the text will change any time the variable is reassigned. Dynamic text

Figure 12.1a and 12.1b. Enhancing Clarity with Text.



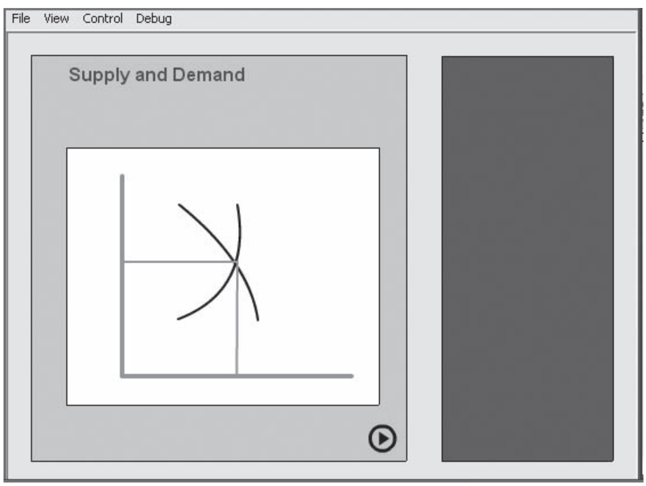
is useful any time a Flash screen is designed to be used as a template. For example, if one has text that requires four pages to display it all, the content should be split up into four roughly equivalent sections. Each section can be assigned to a variable and then dynamically sent to the screen as the user moves from screen to screen (to build this type of navigation, refer to the Flash guide Button Symbol). The big advantage with this method is that the content can be changed instantly without worrying about the layout of the page and the attributes of the text (e.g., font, font size, bold, etc.).

For example, Figure 12.1 demonstrates how these methods could be used to present text to the learners.

Additionally, support graphics should be made available that strengthen the text. Obviously, to meet this objective the learners will have to be presented with an image illustrating a supply-and-demand graph. To draw this graph, refer to the Flash guide **Drawing Tools**. Flash's drawing tools create vector graphics that can be resized and reused without losing resolution. In other words, if a lesson requires the same representation in multiple places, images drawn in Flash do not have to be re-created. The Flash guide on **Graphic Symbols** can be of great assistance in repurposing graphics.

Figure 12.2 demonstrates the use of graphics.

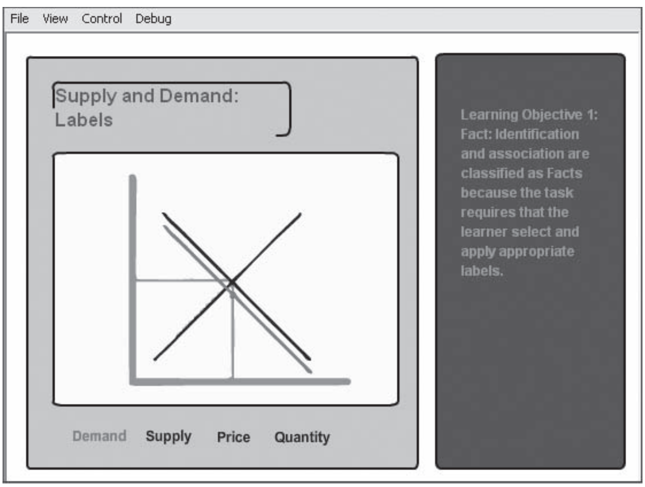
Figure 12.2. Enhancing Clarity with Graphics.



Figure/Ground Separation. This strategy is central to the objective. In order for the learners to be able to identify the different structures in the graph they must be able to determine which structure a label is referring to. A supply-and-demand graph has numerous components so, to avoid confusion, each element must be isolated from the others. The "figure" must be separated from the "ground." One way to create this connection is to use arrows; however, that technique has some drawbacks. The more complicated the figure, the more cluttered the image. However, with the use of Flash, you have the ability to demonstrate one connection at a time. The easiest way of doing this is to use a Flash button with the rollover effect. For example, each element in Figure 12.3 has been connected to its own button. Each time the user's cursor is above a particular button, the image changes. Recall that with a button rollover you can make not only the button image change but also you can have an image(s) appear anywhere on the screen. These images can cover images on other layers. In this example, when a learner places the cursor on a label, the label turns color and an image of a part of the graph is overlaid with the same graphic but a different color.

Layout. Headings help inform the learners as to what is important. Headings focus the learners' attention on the task at hand. For example, for this

Figure 12.3. Overlay.



Adobe product screen shot(s) reprinted with permission from Adobe Systems Incorporated.

objective, the learners should be informed of what the learning goal is. At all times, the learners should have access to the objective itself. This can be accomplished by inserting headings that describe the topic as well as headings that describe the objective. It is also a good idea for these headings to be placed on the screen in a consistent manner, so that for every topic the learners can instantly identify the purpose they are engaged in. This can be accomplished easily with **Dynamic Text**, which allows the layout and style to be maintained while changing the content. Figure 12.1 illustrates this method.

Cognitive Load Management

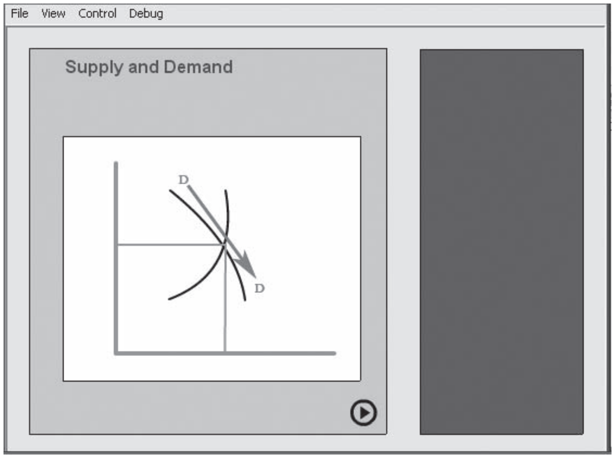
Graphic Organizer. One of the challenges with mastering this objective is consistently associating the labels with the shapes of the curves. By providing a graphic organizer, we can help the learner associate the slopes with the logic behind the shape. If we can provide them with a table that connects this information, we allow the learner to make this connection all at once, which reduces the cognitive load imposed by switching from screen to screen.

Structural Management

Elaboration. Often by providing the learner with some additional information, that goes beyond the immediate objective, can be helpful in connecting the new content with past experience and prior knowledge. In this case, the learner might be informed that, "The price is viewed as the variable that determines quantity supplied and quantity demanded, and we usually put the dependent variable (which here is quantity) on the vertical axis." (http://gregmankiw.blogspot.com/2006/09/who-invented-supply-and-demand.html). This may help them recall the illogic of the axis for this type of graph. This can be implemented with the **Dynamic Text** tool.

Mnemonics. It also may be helpful to provide the learners with a mnemonic. For example, the demand curve slopes downward. The D in demand can be associated with the D in down. This instructional message can be emphasized by reusing the graph of the supply and demand graph (using the Flash guide **Drawing Tools**) and by animating the letter D from left to right (using the Flash guide **Motion Tween**). The mnemonic will have to be explained with text (using the Flash guide **Dynamic Text**). Figure 12.4 illustrates this method.

Figure 12.4. Highlighting Downward Curve.



Possible Practice Strategies

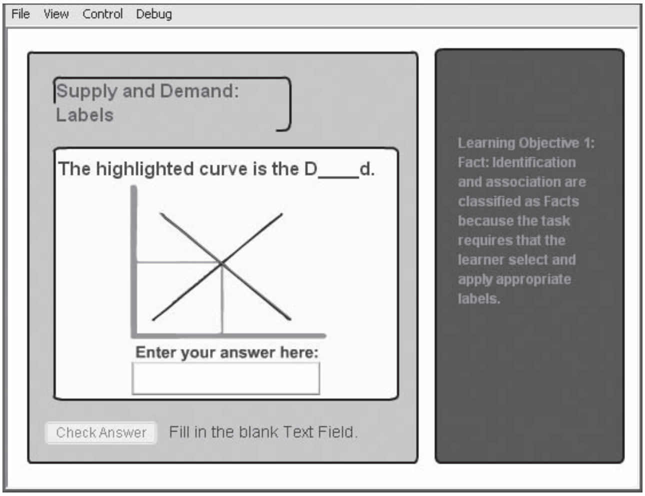
Since this objective is to match labels with parts, it is a good idea to select a practice sequence that emphasizes the naming. The scope sequence is appropriate because it could provide hints as to the naming the parts. Recall that the scope sequence entails removing certain words and letters and replacing them with various degrees of hinting.

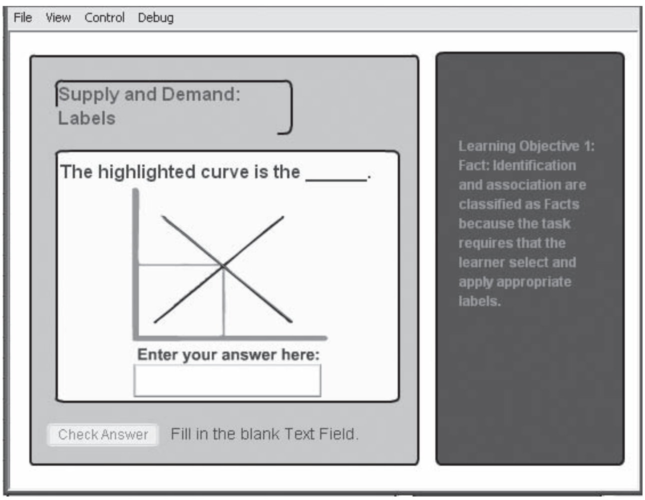
A scope practice sequence can be implemented with the Flash guide's **Short Answer Learning Component**. When using this method, you will have to reuse the supply-and-demand graph that was created with the Flash guides **Drawing Tools** and **Graphic Symbol Tools**. The graph will have to be manipulated a number of times to highlight each component. Those manipulated graphs will then have to be presented on the same screen as the **Fill in the Blank Learning Component**.

Be sure to modify the background of the learning component so that it integrates with the rest of the interface. You will need to create a number of versions for each label that includes various stages of hinting. In Figure 12.5 you can see how a scope sequence might be displayed.

You may also need to create a scope sequence that requires the learner to select the appropriate part of the graph based on the same type of hinting

Figure 12.5. Scope Practice Sequence.





Objective 2 (Facts). Given a list of key economic theorists, you will be able to associate their names with their relevant ideas. You will be able to perform this task with a 75 percent rate of success.

mentioned above, but instead of typing in letters and words the users select portions of the supply-and-demand graph to indicate their response. This can be accomplished following the Flash guide **Hot Spot Learning Component** in tandem with the **Drawing Tools** and **Graphic Symbol Tools.**

Possible Presentation Strategies

Attention Management

Clarity. This objective involves comprehending verbal discourse and is entirely a text-based activity. Special attention should be made to writing clear, easily understandable content. The content should be displayed on a background that separates the elements on the screen. To make the background interface, you will need to follow the Flash guide **Drawing Tools**. Since the background interface is likely to be used repeatedly, it should be combined into a **Graphic Symbol**. The text, title, and objectives should be presented on the screen by following the Flash guide **Dynamic Text**. Pages will have to be navigated by implementing the procedures on the Flash guides **Button Symbol** and **Navigation Code**.

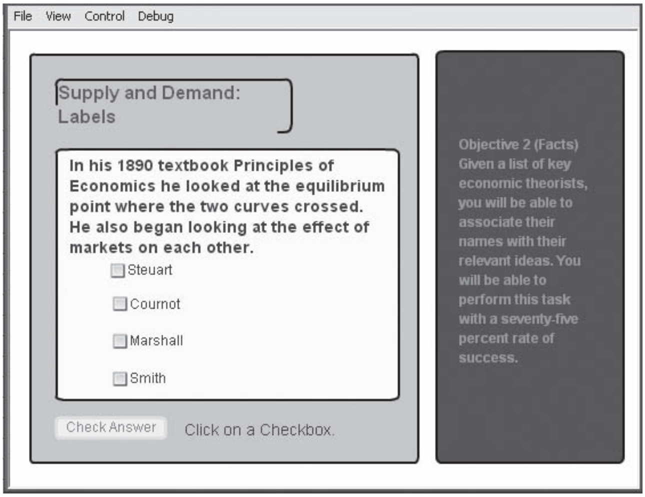
This type of online learning application is often called a of "page turner." Some applications consist entirely of "page turning," which can be dull and use little of the power of Flash. However, they are appropriate when you need to present text information to the learners.

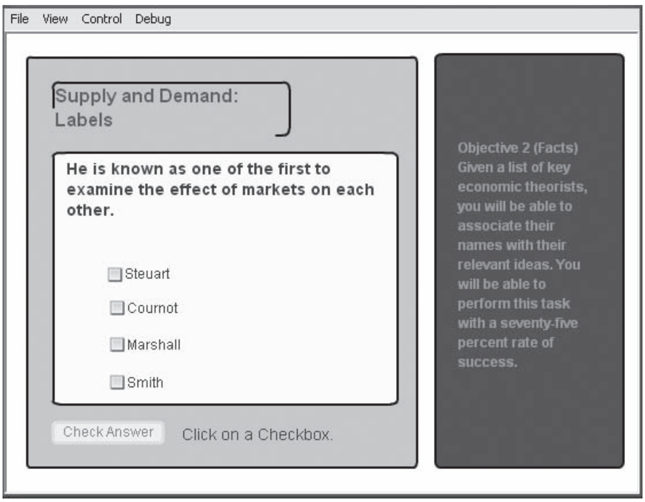
Possible Practice Sequences

This objective requires the learners to match verbal discourse with labels. Verbal discourse is a type of Fact that requires comprehension as well as matching. The Structural Management Strategy provides enough support so that all the steps connecting discourse to labels is relatively small. Recall that the Support practice sequence begins by providing lots of context and proceeds by removing that context. The **Multiple Choice Learning Component** is an appropriate selection because the labels fit nicely as distracters. Figure 12.6 demonstrates the implementation.

Objective 3 (Concept). Given a supply and demand graph, you will be able to classify the demand curve as being elastic, inelastic, perfectly elastic or perfectly inelastic. Will be able to accomplish this task seventy-five percent of the time.

Figure 12.6. Support Practice Sequence.





Possible Presentation Strategies

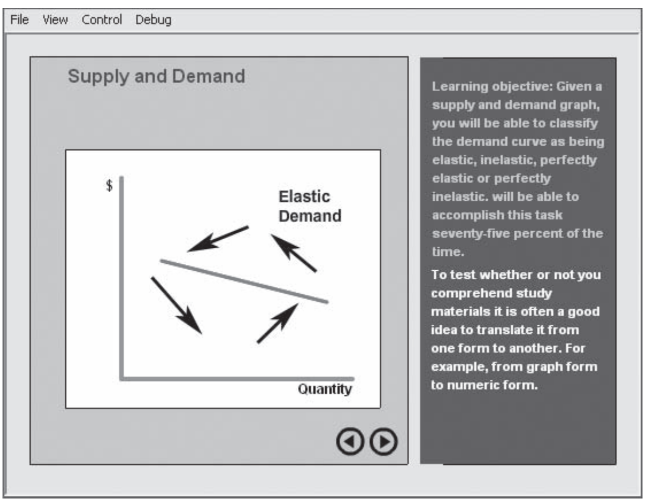
Co-Presentation. To understand the concept of elasticity requires knowing the verbal definition and the graphical definition. The co-presentation strategy indicates that both should be presented on the screen at the same time. However, the challenge is that the demand curve graph can take on a number of positions for each category (elastic, inelastic, perfectly inelastic).

The first step is to present the text on the screen using the Flash guides **Static Text** and **Dynamic Text**. The supply-and-demand graph frame can be drawn (see Flash guide **Drawing Tools**). The demand curve can be created with the **Drawing Tools**. This can be done by drawing a simple line. This line can then be turned into a Symbol (see Flash guide **Symbols**). Elasticity is classified according to the slope of the demand curve. Each category of Elasticity (elastic, inelastic, perfectly elastic, and perfectly inelastic) can be represented as a range of values, and thus a range of demand curve slopes. The symbol can then be animated to rotate upon itself to demonstrate this different values (see Flash guide **Motion Tween**). This lesson is demonstrated in Figure 12.7. The arrows demonstrate the direction of motion.

Possible Practice Strategies

Modality. For this objective, learners ultimately need to be able to appropriately classify un-encountered examples of the concepts elastic and inelastic. However, practice items at the beginning of the sequence may have items that are familiar to the learner. For that reason, the Modality will be manipulated in the practice sequence. Familiar and concrete examples will be presented initially and, as the learner is successful, those examples will change

Figure 12.7. Animated Co-Presentation.



to ones that are unfamiliar and abstract. For example, gasoline is a product that learners will have experience with that is elastic (purchases generally are not affected by the price in the short term). Learners understand the logic of their demand for gasoline. Later in the practice sequence, they may be asked to consider examples for which they have less familiarity. Since the learners are primarily being asked to identify examples as being a member of one of two classes the **True/False Learning Component** will be used to build the practice sequences. Figure 12.8 demonstrates this type of sequence.

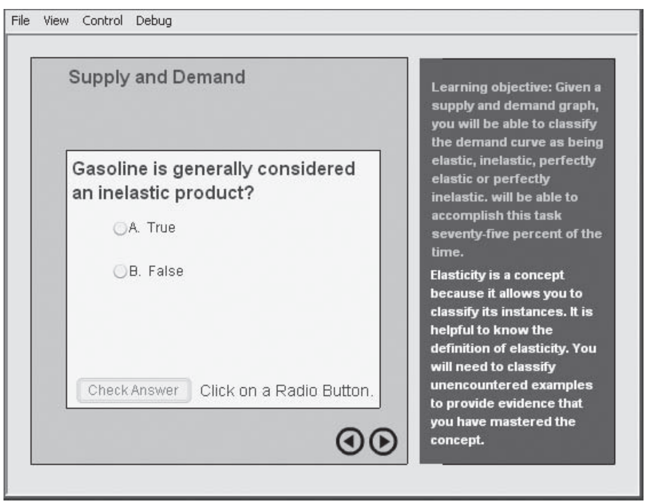
Objective 4 (Procedure). Given a scenario describing a customer's buying patterns, you will be able to calculate the price elasticity of demand. Your calculation will be within 5 percent of the actual elasticity.

Possible Presentation Strategies

Attention Strategy

Demonstration. This objective requires learners to be able to calculate price elasticity. Calculation requires learners to be able to recall the formula and

Figure 12.8. True/False Practice Sequence.



apply the procedure for manipulating it. This can best be accomplished by using the demonstration presentation strategy. The steps involved in the calculation can be put on the screen with the **Drawing Tools**. It also may help to make different variables of the equation Flash to draw attention to them. Variables that fade in or change color can be accomplished with a combination the **Separate Text** and **Motion Tween** functions (see Flash guides). When demonstrating equations, it is often a good idea to have the steps emerge sequentially on the screen. This emergence can be controlled by placing each step on its own layer and revealing more content on successive frames by allowing the learner to navigate to them through a button (see **Symbols** Flash guide).

A number of these demonstrations may be useful if they demonstrate working with different values. A number of examples can help solidify the procedure in the learner's long-term memory. Last, the procedure should be presented in a flow chart so that the learners can see all of the steps at once instead of seeing them over time. Flow charts display information that occurs over time simultaneously and thus can reduce cognitive load. Flow charts can be constructed with Flash's native **Drawing** tools. However, it is often more efficient to create a flow chart using a tool like Inspiration or Visio (see **Importing** Flash guide).

Possible Practice Sequences

The terminal goal for this objective is to be able to calculate elasticity. However, the first step is to be able to identify the procedures for manipulating the equation. In this case, it would assist the learner by have two separate practice sequences; one for fading support for the steps involved in the procedures and another to fade support for completing the calculation. These practice sequences can be implemented with the learning components **Drag and Drop** and **Fill in the Blank** (see Flash guides).

Objective 5 (Principle). Given a scenario in which both the Supply and Demand curves shift, you will be able to state the equilibrium point in reference to the newly established Price and Quantity figures; you will be able to perform this task 90 percent of the time.

Possible Presentation Strategies

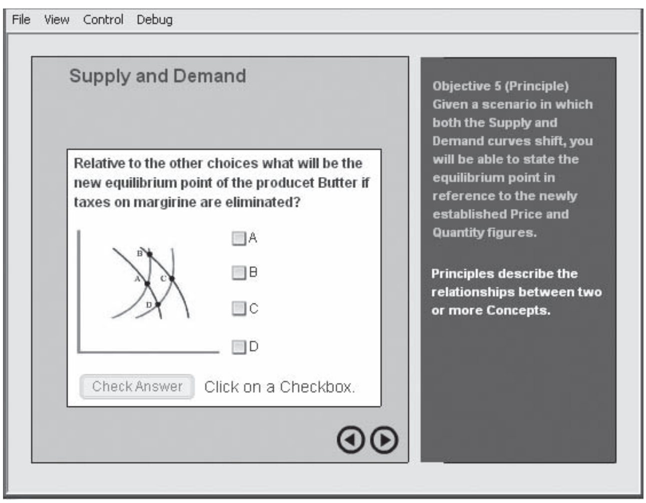
Structural Strategy

Simulation. The shifting of the supply and demand curves needs to be demonstrated graphically. The graphs will have to be drawn (see the **Drawing Tools** Flash guide). Perhaps the best way to demonstrate how the relationships change relative to one another is to independently animate both curves (see the **Motion Tween** Flash guide). The animation can be designed to be controlled by the user to create a simulation (see the Flash guides **Movie Clip Control** and **Variable Simulation**).

Possible Practice Sequences

A practice sequence involving prediction needs to be implemented. Manipulating the Modality may be a good choice. The learners can be provided with support examples that are familiar and, as the sequence progresses, they can be introduced to more abstract scenarios. This type of sequence can be implemented with the **Multiple Choice Learning Component** (see **Multiple Choice** Flash guide). Figure 12.9, illustrates the implementation of this component.

Figure 12.9. Changing the Modality.



Summary

The important ideas in this chapter include:

- Each type of objective requires specific instructional strategies.
- Each type of objective requires specific Flash techniques.
- Not every appropriate strategy and technique is used for each objective.

COMING UP: DISTRIBUTING FILES

The next chapter discusses how to distribute Flash applications. Flash, as an online learning tool, must be made available through the Internet in order to reach learners at a distance. Flash must be integrated into web pages or learning management systems and to do that requires specific techniques.

13

Distributing Files

Guiding Questions

- How can Flash be distributed?
- How long does it take to deliver Flash applications?
- How can Flash applications be delivered faster?
- How can Flash be delivered with and through web pages?

Chapter Overview

In this chapter, distributing Flash files will be discussed. You will learn how to publish a Flash file, how to embed Flash files into a web page, how to write the html to connect to a Flash file, how to post a Flash file on a web server, and how to distribute a Flash file on CD-ROM.

Bandwidth Analysis

Flash can delivery content with a minimal amount of bandwidth consumption. When you are ready to publish your application, you can obtain a detailed report on the bandwidth profile that your application will produce. When you test your movie, a .swf file is created. You can view the bandwidth profile from the .swf file interface (be sure to view it through the Flash Application Environment.

To view the Bandwidth Profiler, from the Menu bar of the .swf, select View and then Bandwidth Profiler.

Publishing

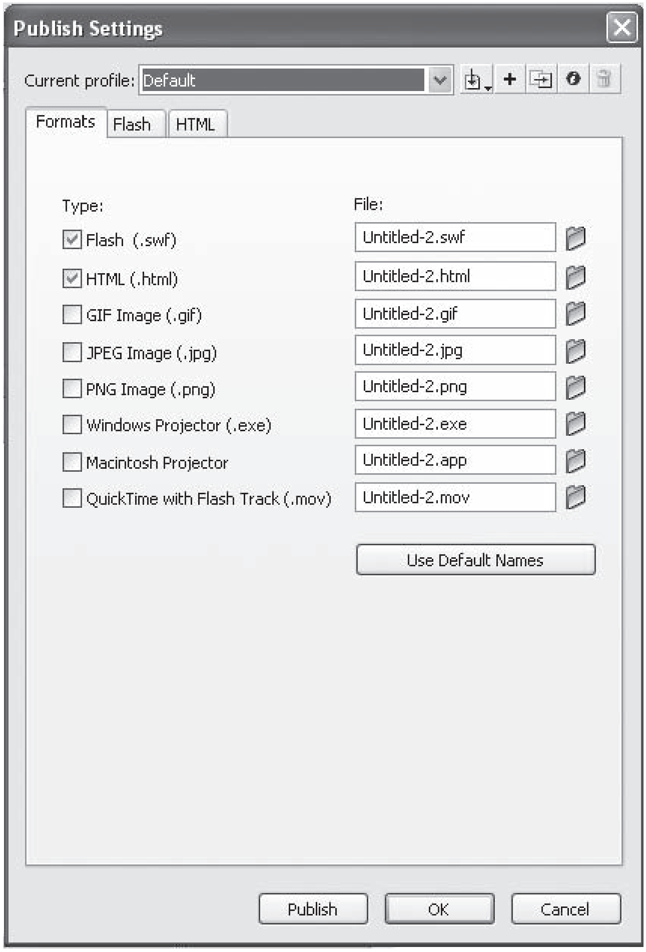
Note: Each time you test a Flash movie (Ctrl + Enter) a .swf file is created that allows you to see what the final application will look like and how that application will perform. The Flash .swf files can be posted directly on a web server. However, there may be times when it is appropriate to publish files directly or they can be published to link through an .html file.

Publish Settings

- **Note:** Under the Format tab there are eight options (Figure 13.1). The first two are selected by default and will publish a .swf file and an .html file.
- **Note:** The options Gif Image, JPEG Image, PNG Image publishes a single consolidated file of the application.
- **Note:** the Windows and Macintosh Projector options produce a file that can be placed on a CD-ROM or executed directly from a PC or Macintosh without connecting through a web browser.

The Version pull-down menu (Figure 13.2) allows you to choose which version of Flash player needs to be used to view the .swf files once they are published. The latest version should generally be used unless you know a particular version is the only one available to your learners (this could happen if a user is working on a closed-system that is not connected to the Internet and cannot download the free updates to Flash player.

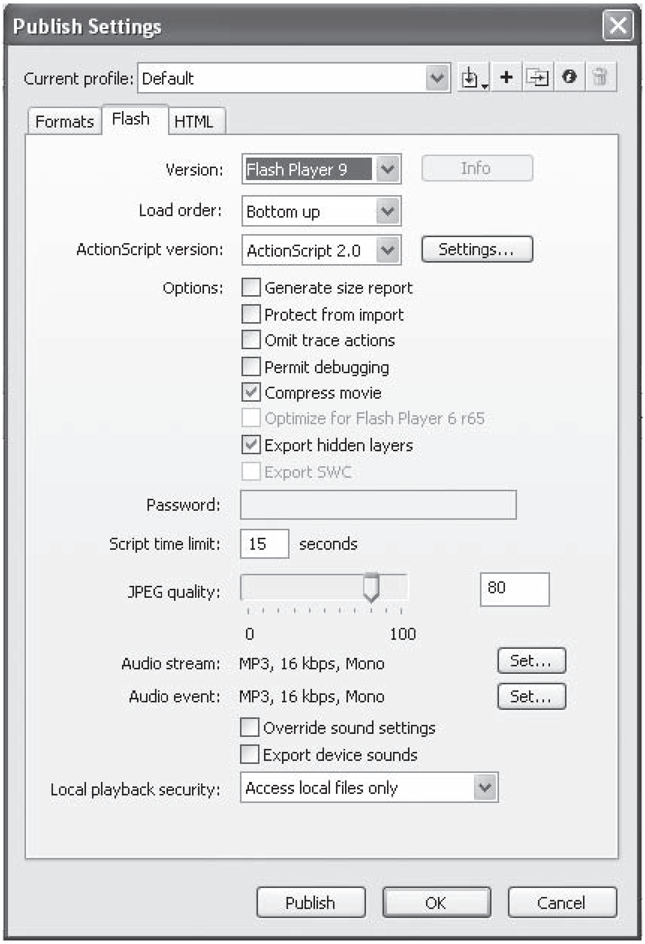
Figure 13.1. Format Tab: From the Menu Bar, Select File, Then Select Publish Settings.



The load order pull-down menu allows you to tell Flash which layers should be downloaded and presented to the learner first. Remember that the layers near the top of the screen are "stacked" on top of the layers toward the bottom of the screen.

The ActionScript version describes which version of ActionScript is in use. The examples in this text all use ActionScript 2.0.

Figure 13.2. Version Pull-Down Bar.



The checkboxes allow you to take specific actions and obtain specific information about the application as follows:

- **Generate size report:** Tells you how large the application files are.
- **Protect from import:** Prevents users from taking your .swf files and re-editing them in the Flash Development Environment.
- **Omit trace actions:** "Trace" is a function that prints to the output screen. It is often useful for troubleshooting; however, you may want to hide the output from the learners.

- **Permit debugging:** Flash has a "debugger" (a tool for solving programming problems) that can be used on .swf files. You may want to enable this function if you are having difficulty with your ActionScript running properly.
- **Compress movie:** This checkbox gives you another opportunity to reduce the size of the .swf file.
- **Export hidden layers:** Layers can be hidden or unhidden, but normally hidden layers are exported and viewable.

The Password text box allows you to put in a password for users to use to use some restricted functions (such as debugging).

The Script Time limits the time that Flash gives to ActionScript to function. Leave it at its default setting.

JPEG quality allows you to further compress the application. However, if quality images are critical for you learners to be able to understand the application's content, then be careful not to reduce the quality too much.

The Audio settings allow you to modify the type and quality of the audio. A low setting will reduce the bandwidth required.

The HTML tab allows you to set parameters regarding HTML, including size and alignment.

The template pull-down menu (Figure 13.3) allows you to see the all of the output choices. In most cases, you will choose Flash only; however, if you will be tying the application to a learning management system, then you will need to select the AICC or SCORM options.

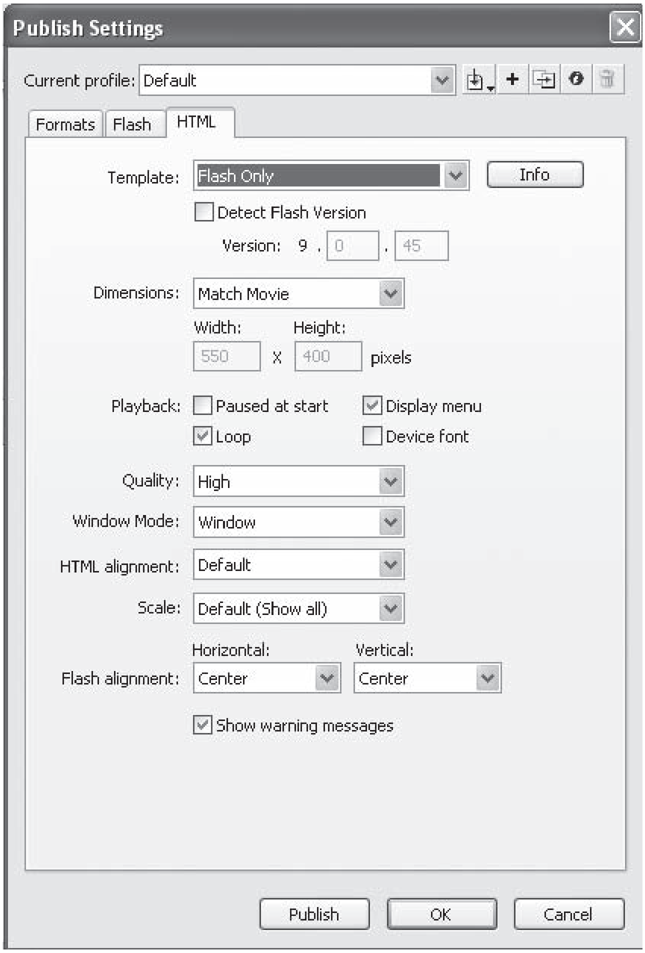
Check the Detect Flash Version to have Flash automatically check the version the learner is using. If learners don't have the version you require, a web page will be presented to them with a link to Adobe that allows them to download the required version.

The Dimensions pull-down allows you to adjust the size of the files that you create.

The Playback checkboxes allow you to control when an application begins and how the learner can control that starting time.

The Quality pull-down menu adjust the degree of anti-aliasing. Aliasing can be thought of as the distortion created by sampling. This distortion can be compensated with by anti-aliasing. Anti-aliasing is processor intensive,

Figure 13.3. Template Pull-Down Menu.



so if you choose High quality, be sure the learners are using computers with plenty of processing power.

The Window Mode pull-down menu allows you to select how the .swf file interacts with the HTML page. The default setting is Window, which places the window on top.

The HTML alignment pull-down menu determine the position of the .swf in a browser.

The Scale pull-down is useful if you have chosen a percentage in the Dimensions pull-down; it allows some control over the display.

The Show Warning Messages checkboxes will show a message if there is any conflict within the HTML code.

Note: Changing any of these options overrides settings in the made during the development of the application, so it is best to keep the settings at their default unless you have a specific reason for changing them.

Files Created

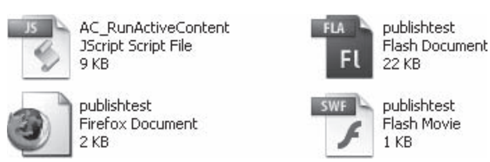
In addition to the original Flash application file (.fla), the publishing function (Figure 13.4) creates the .swf file, an .html file that will embed the .swf file, and AC_RunActiveContent.js JavaScript that is necessary for some run content within some browsers.

It is important to upload all of these files that in the same folder on a web server (you do not need to post the .fla file). You will use the .html file to give to the learner. For example, www.mywebserver.edu/Flash/publishtest.htm will take you to the files described above.

Configuring Web Servers

Web server management is beyond the scope of this text. However, it should be noted that the files created through publishing should work on any standard web server. The one modification that may need to be implemented is the declaration of the MIME (Multipurpose Internet Mail Extensions) type. The MIME type for Flash files should be set to the .swf file extension. Without the .swf MIME type declared, the server and browsers will not know how to process the Flash format. Contact your server administrator for

Figure 13.4. The Files That Are Created When You Select Publish.



more details. In most cases, the MIME type will have been set appropriately and you will not have to change any settings.

Manually Embedding a Flash File

If you have already created a web page in which you would like to embed a .swf, you should follow the same procedure as above; however, once you have published the files mentioned above, discard the .html file. Place the .swf in the same folder as your web page and add the following html to your code:

```
<object data="publishtest.swf" type="application/x-shockwave-flash"
width="500" height="500">
    <param name="movie" value="publishtest.swf" />
</object>
```

Be sure to modify the name of the .swf files and to replace the width and height with appropriate pixel sizes.

Summary

This chapter reviewed the procedures for publishing your Flash application. A number of variables must be considered when publishing files to give your learners the best experience possible.

COMING UP: EVALUATION

The next chapter is on evaluation, the final step of the instructional design process. You must determine whether your instruction actually meets the goals that you intended. In other words: Does it work and does it work well? The next chapter reviews why user tests are critical to the revising of materials.

14

Evaluation

Guiding Questions

- How do you know whether your instruction has been effective?
- How do you know whether your objectives have been met?
- What are the components involved in an effective evaluation?
- How can Flash send performance data?
- Why are user tests important?
- What are the differences between formative and summative evaluation?

Chapter Overview

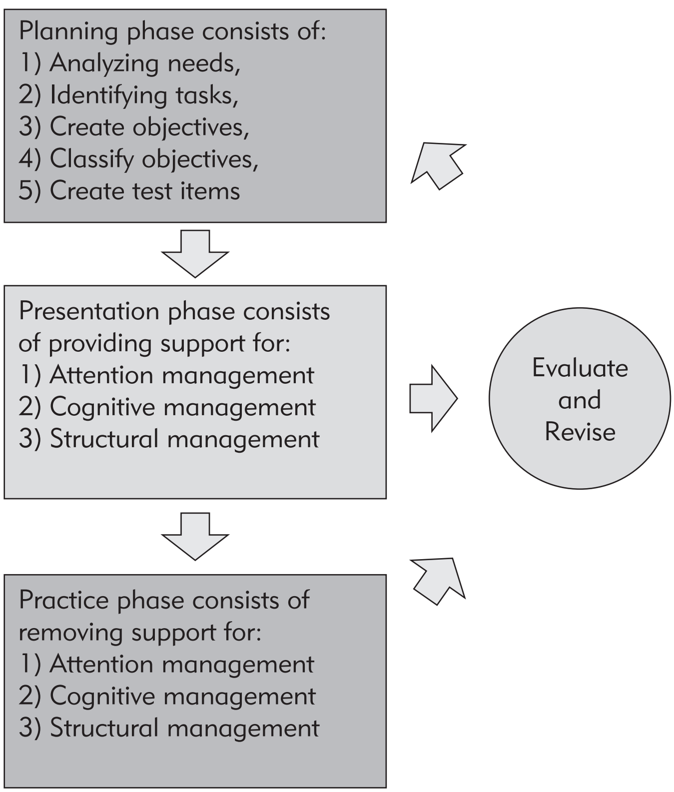
The final step in designing online learning is to evaluate and revise the instructional materials that have been constructed. This process occurs, to some extent, throughout the design and development process. However, it is

important to focus on evaluation at the end of the process because only then can the application be viewed holistically.

Formative Evaluation

Formative evaluation is undertaken periodically while online learning is being designed and developed. Formative evaluation is evaluation done before it is finished. The advantage of formative evaluation is that problems can be identified early. Problems have a tendency to multiply when decisions are being made based on what has already been designed and developed. Figure 14.1 demonstrates how evaluation and revision relates to the entire Online Learning design and development process.

Figure 14.1. Instructional Design Process.



Planning Phase

The client should be consulted in the Planning stage once the needs have been identified and once the objectives have been declared. This can save a substantial amount of time, particularly when a designer is working with an external client. This ensures that the client and the designer are on the same page. Any discrepancies can be worked out before any further time and resources are invested in the project.

It is also important to share the needs assessment and learning objectives with subject-matter experts. They can provide an expert's view of whether the important problems are going to be adequately addressed. Identifying needs and analyzing tasks is the foundation on which the rest of the development will rest. It is important to ensure that this part of the planning phase has been adequately addressed.

Prototype

One useful strategy is to create a prototype. A prototype is a sample or part of an application that allows you to test and demonstrate a specific part or function. For example, a working prototype could be created in Flash that only has the content and interactions without graphics. Often graphics are tailor-made and dependent on the content. Those graphics might have to be remade if changes are required to the content.

Usability Testing

Usability refers to an application's ease of use. As you design and develop your Flash application for online learning, you will make a number of assumptions about what the learner will experience. There are several areas that you can test, for example, making sure the application runs well on different sized screens, operating systems, and different browsers. Unfortunately, you will not be in the best position to judge because designers and developers tend to be too close to the application; many elements will appear to you to be clear and appropriate because you are familiar with the context. Your users will rarely have this level of familiarity and will often find the application confusing.

Designers and developers tend to report that a usability test is one of the most valuable events in the design process. Often, testers will provide a wealth of information on topics that the designer has never thought of addressing. It is important, however, not to engage in this process if you do not plan to listen to and implement suggestions. For example, you it makes little sense to have users test the navigation of an application if the clients have imposed one. Of course, if you believe a decision has been imposed that affects the instructional quality of an online application, you might use the data collected from usability tests to convince them that changes need to be made.

Usability tests do not have to be elaborate. Simply observing users without commenting is often sufficient to identify deficiencies and confusing elements in an application. It is important not to verbally, or through body language, provide information to the testers that they cannot obtain for the application. Remember, your target population will not have you sitting next to them. It is also important to remember that mistakes your testers make are because of the design and not because of any limitations they might have, if you keep that in mind, you will adopt an attitude of openness, which will assist you in collecting information.

It is important to select testers who are similar to your target population. For example, if the target population is college educated, mid-level managers aged thirty-five to fifty, you will need to find testers who meet that same demographic. You will need about five testers from that demographic to give you a comprehensive idea of how well your application works. Further, it is important that you not reuse testers; once they have encountered the application once, they will have a biased experience.

Additionally, online learning applications should be tested over a number of different bandwidth connections. You should decide what is the lowest permissible bandwidth configuration tolerable. You also must consider that the Internet rarely provides consistent throughput. The more nodes that a user connects through, the more likely that the data transmission will be compromised. It is important to identify a number of sites that you will be delivering to and test the connections during different time periods of the day and week.

While you are observing, you should note each area of difficulty in a table so that you can compare different testers' responses. This will help you identify problems that consistently come up. One user having difficulty in a particular area may be an anomaly; however, if multiple testers are reporting challenges, it is a sign that there is something wrong with the application. Problems should be prioritized according to which ones cause the most users difficulty.

After you have silently observed and taken notes of the tester working through the application, you can follow up with some targeted questions. Table 14.1 includes a list of questions that can inform a user test.

Table 14.1. Post-User Test Questions.

What is confusing?	How can it be improved?	
Were the objectives easily comprehended?	Is the language used clear and easily understood?	Does it load in a timely manner?
Did you have to wait for content?	Is there a method or responding to the developer?	Does the application have a consistent look?
Is navigation intuitive and consistent?	Is the placement of graphics consistent?	
Was it easy to find the information you needed?	Was it easy to navigate?	
Did things work as you expected?	Were you bored at anytime?	
Were the color combinations pleasing?	Did the graphics support the text?	
Were practice opportunities clear?	Were practice sequences staged appropriately?	

Summative Evaluation

Summative evaluation comes after the application has bee designed, developed and implemented; it is concerned with results and outcomes. The two big questions that summative evaluation answers are (1) Did the learners learn? and (2) Have the needs of the sponsoring organization been met? Whether the learner has learned can be evaluated in the short term and for the long term. The test that was designed to match the learning objectives in the planning phase should provide a good indication of whether the learners have learned the material.

The data describing how the learners perform can be collected and sent back to you (see Saving and Sending Data). This data gives you an important look at what is working or not working in the application. For example, if everyone is missing a particular question, you can be confident that material was not well instructed or that there is a problem with the questions. Either may need to be revised to ensure learning.

Long-term retention can be evaluated simply by extracting the assessment portion of the application and resending it to the learners a few months later; this aspect of online learning is an advantage over a face-to-face situation. With online learning users, can be contacted well after the original instruction to determine whether they not only learned but retained the knowledge and skills.

The final summative evaluation technique is to determine whether or not the problems that existed that prompted the call for an instructional intervention have been resolved. For example, if a new piece of machinery was the event that triggered the necessity for training and if the target employees are successfully using the machine, then the needs have been satisfied. Another example would be if complaints to a customer service center were reduced after the training was implemented.

An onsite visit or an interview with managers and co-workers or colleagues may be helpful in determining whether a need has been met. The important thing is to gather data after the instruction and match it with data gathered during the needs assessment from the planning phase. As with all data collection for evaluation, it is a good idea to provide responders with an

opportunity to provide some open-ended responses. If needs have not been met, it is a sign that the instruction needs to be revised.

It is also a good idea evaluate the process of development at this point. If this was a team project, how well did the team work together? Did you have the necessary design and technical skills? What resources are needed for future projects? Additionally, you should consider the efficiency of the process. How many hours did it take to develop the applications? What were the costs involved? How many learners benefited. If the Flash application was a part of a larger instructional event, then you should determine how well it was integrated. Was Flash the best platform for the content delivered? Should more be added?

Summary

This chapter discussed formative and summative evaluation techniques used to ensure that your instruction meets the learning objectives and is used by the learners as you have intended. Instructional materials are always in a state of revision. You should be continuing to ask for feedback from your learners on their experience with your applications.

This chapter concludes the text. Please refer to the text's website for further details on *Designing Online Learning with Flash*.

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ABOUT THE AUTHOR

DAVID RICHARD MOORE, PH.D., received a doctorate in instructional systems design from Virginia Polytechnic Institute and State University (Virginia Tech) in 1995. His research focuses on instructional designs for assessment and evaluation using interactive multimedia and network computing. Much of this research is conducted through specially designed computer-based interactive systems (often using Flash). Dr. Moore is an active speaker and consultant, most often on topics related to interactive computer-based training. He is currently an associate professor and program coordinator of the Instructional Technology and the Computer Education and Technology programs at Ohio University.

Pfeiffer Publications Guide

This guide is designed to familiarize you with the various types of Pfeiffer publications. The formats section describes the various types of products that we publish; the methodologies section describes the many different ways that content might be provided within a product. We also provide a list of the topic areas in which we publish.

FORMATS

In addition to its extensive book-publishing program, Pfeiffer offers content in an array of formats, from fieldbooks for the practitioner to complete, ready-to-use training packages that support group learning.

FIELDBOOK Designed to provide information and guidance to practitioners in the midst of action. Most fieldbooks are companions to another, sometimes earlier, work, from which its ideas are derived; the fieldbook makes practical what was theoretical in the original text. Fieldbooks can certainly be read from cover to cover. More likely, though, you'll find yourself bouncing around following a particular theme, or dipping in as the mood, and the situation, dictate.

HANDBOOK A contributed volume of work on a single topic, comprising an eclectic mix of ideas, case studies, and best practices sourced by practitioners and experts in the field.

An editor or team of editors usually is appointed to seek out contributors and to evaluate content for relevance to the topic. Think of a handbook not as a ready-to-eat meal, but as a cookbook of ingredients that enables you to create the most fitting experience for the occasion.

RESOURCE Materials designed to support group learning. They come in many forms: a complete, ready-to-use exercise (such as a game); a comprehensive resource on one topic (such as conflict management) containing a variety of methods and approaches; or a collection of like-minded activities (such as icebreakers) on multiple subjects and situations.

TRAINING PACKAGE An entire, ready-to-use learning program that focuses on a particular topic or skill. All packages comprise a guide for the facilitator/trainer and a workbook for the participants. Some packages are supported with additional media—such as video—or learning aids, instruments, or other devices to help participants understand concepts or practice and develop skills.

- *Facilitator/trainer's guide* Contains an introduction to the program, advice on how to organize and facilitate the learning event, and step-by-step instructor notes. The guide also contains copies of presentation materials—handouts, presentations, and overhead designs, for example—used in the program.

- *Participant's workbook* Contains exercises and reading materials that support the learning goal and serves as a valuable reference and support guide for participants in the weeks and months that follow the learning event. Typically, each participant will require his or her own workbook.

ELECTRONIC CD-ROMs and web-based products transform static Pfeiffer content into dynamic, interactive experiences. Designed to take advantage of the searchability, automation, and ease-of-use that technology provides, our e-products bring convenience and immediate accessibility to your workspace.

METHODOLOGIES

CASE STUDY A presentation, in narrative form, of an actual event that has occurred inside an organization. Case studies are not prescriptive, nor are they used to prove a point; they are designed to develop critical analysis and decision-making skills. A case study has a specific time frame, specifies a sequence of events, is narrative in structure, and contains a plot structure—an issue (what should be/have been done?). Use case studies when the goal is to enable participants to apply previously learned theories to the circumstances in the case, decide what is pertinent, identify the real issues, decide what should have been done, and develop a plan of action.

ENERGIZER A short activity that develops readiness for the next session or learning event. Energizers are most commonly used after a break or lunch to stimulate or refocus the group. Many involve some form of physical activity, so they are a useful way to counter post-lunch lethargy. Other uses include transitioning from one topic to another, where "mental" distancing is important.

EXPERIENTIAL LEARNING ACTIVITY (ELA) A facilitator-led intervention that moves participants through the learning cycle from experience to application (also known as a Structured Experience). ELAs are carefully thought-out designs in which there is a definite learning purpose and intended outcome. Each step—everything that participants do during the activity—facilitates the accomplishment of the stated goal. Each ELA includes complete instructions for facilitating the intervention and a clear statement of goals, suggested group size and timing, materials required, an explanation of the process, and, where appropriate, possible variations to the activity. (For more detail on Experiential Learning Activities, see the Introduction to the *Reference Guide to Handbooks and Annuals*, 1999 edition, Pfeiffer, San Francisco.)

GAME A group activity that has the purpose of fostering team spirit and togetherness in addition to the achievement of a pre-stated goal. Usually contrived—undertaking a desert expedition, for example—this type of learning method offers an engaging means for participants to demonstrate and practice business and interpersonal skills. Games are effective for team building and personal development mainly because the goal is subordinate to the process—the means through which participants reach decisions, collaborate, communicate, and generate trust and understanding. Games often engage teams in "friendly" competition.

ICEBREAKER A (usually) short activity designed to help participants overcome initial anxiety in a training session and/or to acquaint the participants with one another. An icebreaker can be a fun activity or can be tied to specific topics or training goals. While a useful tool in itself, the icebreaker comes into its own in situations where tension or resistance exists within a group.

INSTRUMENT A device used to assess, appraise, evaluate, describe, classify, and summarize various aspects of human behavior. The term used to describe an instrument depends primarily on its format and purpose. These terms include survey, questionnaire, inventory, diagnostic, survey, and poll. Some uses of instruments include providing instrumental feedback to group members, studying here-and-now processes or functioning within a group, manipulating group composition, and evaluating outcomes of training and other interventions.

Instruments are popular in the training and HR field because, in general, more growth can occur if an individual is provided with a method for focusing specifically on his or her own behavior. Instruments also are used to obtain information that will serve as a basis for change and to assist in workforce planning efforts.

Paper-and-pencil tests still dominate the instrument landscape with a typical package comprising a facilitator's guide, which offers advice on administering the instrument and interpreting the collected data, and an initial set of instruments. Additional instruments are available separately. Pfeiffer, though, is investing heavily in e-instruments. Electronic instrumentation provides effortless distribution and, for larger groups particularly, offers advantages over paper-and-pencil tests in the time it takes to analyze data and provide feedback.

LECTURETTE A short talk that provides an explanation of a principle, model, or process that is pertinent to the participants' current learning needs. A lecturette is intended to establish a common language bond between the trainer and the participants by providing a mutual frame of reference. Use a lecturette as an introduction to a group activity or event, as an interjection during an event, or as a handout.

MODEL A graphic depiction of a system or process and the relationship among its elements. Models provide a frame of reference and something more tangible, and more easily remembered, than a verbal explanation. They also give participants something to "go on," enabling them to track their own progress as they experience the dynamics, processes, and relationships being depicted in the model.

ROLE PLAY A technique in which people assume a role in a situation/scenario: a customer service rep in an angry-customer exchange, for example. The way in which the role is approached is then discussed and feedback is offered. The role play is often repeated using a different approach and/or incorporating changes made based on feedback received. In other words, role playing is a spontaneous interaction involving realistic behavior under artificial (and safe) conditions.

SIMULATION A methodology for understanding the interrelationships among components of a system or process. Simulations differ from games in that they test or use a model that depicts or mirrors some aspect of reality in form, if not necessarily in content. Learning occurs by studying the effects of change on one or more factors of the model. Simulations are commonly used to test hypotheses about what happens in a system—often referred to as "what if?" analysis—or to examine best-case/worst-case scenarios.

THEORY A presentation of an idea from a conjectural perspective. Theories are useful because they encourage us to examine behavior and phenomena through a different lens.

TOPICS

The twin goals of providing effective and practical solutions for workforce training and organization development and meeting the educational needs of training and human resource professionals shape Pfeiffer's publishing program. Core topics include the following:

Leadership & Management
Communication & Presentation
Coaching & Mentoring
Training & Development
E-Learning
Teams & Collaboration
OD & Strategic Planning
Human Resources
Consulting