Chapter 2

Design Considerations for Web-Based Learning Systems

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The problem and the solution. The introduction of Internet and Web-based technologies has resulted in changes in the way instructional design models are applied in the creation of instruction delivered via the new media. New resources and constraints must be considered and new questions must be asked and answered. This chapter describes how the traditional instructional design model is modified when designing instruction for these new technologies.

The Internet and Web-based technologies have affected formal learning in the workplace and contributed to improving workplace performance. Although face-to-face, instructor-led training exceeds Web-based training today, the growth in Web-based training continues (American Society for Training and Development [ASTD], 2002). The decision to use Web-based learning has economic components: reduced travel to training sites, economies of scale resulting from repeated offerings of a single course development effort. Web-based learning also has pragmatic components: anytime, anywhere accessibility of training, and just-in-time delivery of training (Kruse & Keil, 1999). Along with these economic and pragmatic benefits come the challenges of designing instruction that takes advantage of the characteristics and features of the Web while at the same time using high quality instructional strategies and methods to meet a diverse set of learning needs and learning style preferences. Traditional instructional design models that have directed efforts to produce quality learning in face-to-face training environments also are being applied to Web-based learning. This chapter presents a brief history of instructional design, describes the paradigms that direct Web development, and delineates the new questions traditional instructional design models must address when used to design Web-based learning environments.

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A Brief History of Instructional Design

Who can identify the beginnings of instructional design? One could argue that the first recorded instances began with Plato in his dialogues. Others might argue for the apprenticeship models that early artisans used to transfer skills from generation to generation. Regardless of its initial beginnings, it is commonly held that the instructional design process that we know today can be traced back to World War II (Rieser, 2001). During this war period, psychologists and educators were brought together to conduct research and to develop military training materials. Robert Gagné and Leslie Briggs, today recognized as pioneers in the field of instructional design, were in that esteemed group of psychologists and educators. In 1962, Gagné developed one of the first models for the systematic design of instruction (Rieser, 2001). Later, in 1965, he identified five domains of learning outcomes and introduced a sequenced set of nine events of instruction that he considered essential for promoting those outcomes (Rieser, 2001). These nine events of instruction serve as a cornerstone of much instructional development today. In 1974, Gagné and Briggs collaborated on the development of a model for the systematic design of instruction (Rieser, 2001). The Gagné and Briggs model and similar instructional design models became known as ADDIE models because of the components that they all had in common: analysis, design, development, implementation, and evaluation.

Although the instructional design process is characterized by the five phases of ADDIE, it also is characterized by the relationship of those phases to each other. The threads that bind the phases of the ADDIE model are behavioral, or performance, objectives. In ADDIE models of instructional design, analysis is conducted to determine the appropriate objectives for an instructional episode to address a performance problem. Instruction is then designed and developed for learners to achieve those objectives. During and after implementation, the instruction is evaluated against the objectives to which it was designed. Thus, the ADDIE process begins and ends with objectives.

ADDIE models are not the only models of instructional design, nor are they the only models used for the design of Web-based learning systems. Recent years have brought great debate among instructional designs about the appropriateness of systematic, step-by-step models like ADDIE (Jonassen, 1994; Willis, 1995). The biggest challenge to ADDIE has come from proponents of constructivist models of instructional design. These challengers classify ADDIE models as objectivist because they originate from the perspective that there is one best path for learning, and "good" instruction provides that path through the learning experience (Dick & Carey, 1996). Constructivist models, on the other hand, originate from the perspective that individuals derive their own reality from a learning experi-

TABLE 1: Characteristics of Objectivist and Constructivist Instructional Design Models

Objectivist	Constructivist
Process is sequential and linear	Process is recursive, nonlinear, and sometimes chaotic
Planning is top down and systematic	Planning is organic, developmental, reflective, and collaborative
Objectives guide development	Objectives emerge from design and development work
Careful sequencing and the teaching of subskills are important	Navigation is open and learner controlled
The goal is delivery of preselected knowledge	The goal is personal understanding within meaningful contexts
Summative evaluation is critical	Formative evaluation is critical
Objective outcome data are critical	Subjective outcome data may be the most valuable

Source: Adapted from Willis (1995) (used with permission).

ence and therefore should be permitted to explore without being hampered by a set of objectives or intended outcomes (Willis, 1995). Willis (1995) distinguished objectivist and constructivist instructional design models along the characteristics shown in Table 1.

Despite the challenges, the ADDIE model remains the most frequently used instructional design model to develop training in business and industry. The objectives focus of the ADDIE model and the performance improvement focus of training in the workplace go hand-in-hand (Gilbert, 1978). Instructional designers with a performance focus tend not to take sides in the objectivist-constructivist debate; rather they focus on selecting the most appropriate strategy to achieve the stated performance objectives, regardless of whether that strategy is objectivist or constructivist in nature. They incorporate the tenets of constructivist instructional design while following the methodology of objectivist instructional design. These tenets include the following (Jonassen, 1994):

1. presenting authentic tasks in context-based learning situations;
2. providing real-world, case-based learning environments;
3. fostering reflective practice in learners; and
4. promoting the collaborative construction of knowledge through social interactions among learners.

Paradigms for Web-Based Learning Development

In addition to objectivist and constructivist paradigms, other paradigms influence the development of Web-based learning interventions. These par-

adigms, which reflect vastly different philosophies of Web-based education, are found in the varying processes that designers follow when converting traditional courses to Web-based courses. The three paradigms are the replication paradigm, the equal education paradigm, and the new domain paradigm (Benson, 2001). Although the equal education and new domain paradigms are the recommended paradigms for the design of Web learning, the replication paradigm remains the paradigm of many new designers of Web-based learning interventions.

Replication Paradigm

In the replication paradigm, Web-based learning replicates, or copies, the materials and strategies used in traditional classroom instruction (Benson, 2001). The instructor's goal is to get information normally taught in the classroom to the distant learner, and the learner's goal is to learn the information and to demonstrate this learning by reciting the information back to the instructor via some type of assessment (Nipper, 1989). Under the replication paradigm, an instructor creates a Web-based course from a traditional course by finding a way to transport the existing course design to the Web. Because there is no sense of a need to redesign the course and course materials, the replication paradigm tends to yield instruction that places the structures and constraints of the traditional classroom, such as class meeting times and semester pacing, onto Web-based education (Holmberg, 1995; Keegan, 1990). For example, a designer subscribing to the replication paradigm might design a Web-based course in which the class met at the same time each week in an Internet chat room. During this time period, the instructor would present (type or speak) the lecture and, time permitting, the learners would be allowed to ask (type) questions. Alternatively, the designer might convert all the course content to Web pages that learners would have to read and then provide periodic written assessments to determine whether they learned what they read.

Equal Education Paradigm

The equal education paradigm is built on the notion that, with proper course design, the educational goals and objectives of learners can be accomplished with either face-to-face or Web-based instruction (Benson, 2001). Simonson's (1999) equivalency theory reflects this paradigm. According to equivalency theory, "Distance education's appropriate application should provide equivalent learning experiences for all students—distant and local—in order for there to be expectations of equivalent outcomes of the educational experience" (p. 7). Simonson makes clear that "equiva-

lent learning experiences for all students" does not mean the same learning experiences. Equivalency theory advocates "the design for distant and local learners of a collection of probably different, but ultimately equivalent, learning experiences" (p. 7). Instead of replicating the materials and strategies of traditional classroom courses, educators holding the equal education paradigm start with learner objectives and make media and instructional strategy decisions that account for the Web-based delivery. These educators believe a redesign of the traditional course is required to ensure the existing classroom course's effectiveness when that course is offered at a distance (Keegan, 1990; Moore, 1989). This redesign is not usually the work of a single individual, as most likely was the case with the traditional classroom course design, but the work of a team including media specialists, content area specialists, instructional design specialists, and learning specialists (Lee & Owens, 2000; Moore, 1993). For example, a designer subscribing to the equal education paradigm might design a self-paced Web learning module for development of a specific skill. Unlike the traditional face-to-face module that required all learners to progress through the content in the same way and at the same speed, the Web-based module would allow learners to take different paths through the content, progressing at whatever speed their mastery of skills dictate. Such a design would require the inclusion of learning scaffolds to support the learners as they progress through the module.

New Domain Paradigm

The new domain paradigm was conceived as educators and technologists attempted to situate Web-based instruction appropriately within the field of distance education (Benson, 2001). Educators subscribing to the new domain paradigm believe that Web-based education has the potential to provide learning experiences of greater educational quality than that of traditional classroom and distance courses.

> Online education is more than a new delivery mode. It is a new learning domain which enables us as educators and as learners to engage in learning interactions more easily, more often and perhaps more effectively, but also to develop qualitatively new and different forms of educational interactions. (Harasim, 1989, p. 62)

In this paradigm, Web-based education is positioned as having the best features of independent study and group-based learning, and of traditional classroom instruction and distance education. Courses constructed using the new domain paradigm start with objectives and require course redesign, as do courses constructed using the equal education paradigm. For example, a designer subscribing to the new domain paradigm might design an interactive Web learning module for development of a specific skill. Although the traditional face-to-face module might be restricted to showing the learners the disas-

trous, and many times dangerous, results of process errors, the Web-based module easily allows learners to experience the results of such errors in a virtual environment.

ADDIE for Web-Based Learning

Although the ADDIE model of instructional design can be used by designers of Web-based learning environments, regardless of the paradigms to which they subscribe, the model must address new questions (shown in Table 2) to be effective. Strategies for addressing each of the new questions are discussed in the following sections.

Analysis

The analysis phase of the ADDIE model, shown in Table 3, typically is composed of two levels of analysis: needs assessment and front-end analysis. Both levels are required when designing Web-based learning environments. During the needs assessment phase, the instructional designer identifies the performance problem and determines if a learning intervention is required. Web-based learning is only an option when the intervention required is a learning intervention.

As shown in Table 4, standard front-end analysis procedures include learner analysis, work setting (situational) analysis, task analysis, critical incident analysis, and objective analysis. Learner analysis and technology analysis must address new questions to accommodate Web-based learning.

Learner analysis. Learner analysis is an in-depth analysis of the intended audience for the learning intervention. The data collected for this analysis procedure includes demographic data, learning style preferences, and entry skill levels. For Web-based interventions, the assessment of learner entry skills must include an assessment of skill with Web-based tools.

Technology analysis. Web-based interventions require that front-end analysis include a technology analysis procedure. According to Lee and Owens (2000), technology analysis is the analysis of available technology to support the following five activities:

1. communications (e.g., e-mail, mailing lists, Internet chat, Web bulletin boards);
2. reference or performance support (e.g., resources on company intranets and Web sites);
3. testing and assessment (e.g., electronic self-assessment, testing, and certification systems);
4. distribution (e.g., company intranets, secure Web sites, file transfer applications); and

TABLE 2: ADDIE Questions for Web-Based Learning

Phase	New Questions
Analysis	What technology skills do the intended learners possess?
	What are the available and accessible technologies?
Design	What skill sets are needed to conduct the design?
	What is the primary delivery mode?
	How is interactivity accommodated?
Development	What is the best interface design given the learning goals and objectives?
	Should the development be outsourced?
	What skill sets are needed to conduct the development?
Implementation	What learner and instructor support are needed for successful implementation?
Evaluation	What are the appropriate Web evaluation measures?
	What are the appropriate Web data collection strategies?

TABLE 3: The Analysis Phase

Component	Purpose
Needs assessment	Determine performance problem and whether learning intervention is required
Front-end analysis	Determine the goals and objectives of the instruction

5. delivery (e.g., course management systems, audio and video servers, multimedia computers, Internet access).

For each of the five activities, the designer determines the availability and accessibility of Web-based technology tools at both the organizational and individual levels. For example, e-mail communications might be available at the organizational level, but the learners in the intended audience for the learning intervention may not have access to it. Likewise, learners may have access to computers and high-bandwidth Internet connectivity at work and have neither at home. A thorough technology analysis would uncover these discrepancies.

In addition to a thorough analysis of technology availability and accessibility, the technology analysis also includes an analysis of the technical support resources and expertise available for the design, development, delivery, and maintenance of the Web-based intervention. Technology tools and associated technical support are critical when considering Web delivery.

The results of the technology analysis set the boundaries for the design of the learning intervention. There is no benefit to designing and developing a

TABLE 4: Types of Front-End Analysis

Type	Purpose
Learner analysis	Identify the background, learning characteristics, and prerequisite skills of the audience New question: What Web-based technology skills do the intended learners possess?
Technology analysis	Identify existing technology capabilities New question: What are the available and accessible Web-based technologies?
Work setting (situational analysis)	Identify environmental and organizational constraints that may have an impact on goals and design
Task analysis	Describe the job-related tasks to be performed as a result of the training
Critical-incident analysis	Determine what skills or knowledge to include in the training
Objective analysis	Write the objectives for the job tasks to be addressed in the training

Source: Adapted from Lee and Owens (2000).

high-bandwidth application if none of learners have high-speed Internet access. Alternatively, if the learning objectives dictate a technology that the technology analysis shows is not available in the organization, the designer has the option of adding the needed technology to the budget for the project.

Design

The design phase builds on the analyses conducted during the analysis phase. During this phase, appropriate media and instructional strategies are selected for the objectives. For Web-based interventions, design has two components: high-level media selection and objective-level media selection. As shown in Table 5, both levels of media selection result in new questions for Web-based learning. Note that some authors (e.g., Lee & Owens, 2000) include media selection in the front-end analysis.

High-Level Media Selection

During high-level media selection, the designer selects the primary delivery mode of the course. The six options include the following:

1. face-to-face;
2. face-to-face with some Web components (e.g., Web-based discussions or resources supplement face-to-face instruction);

TABLE 5: The Design Phase

Component	Purpose
High-level media selection	Select the primary delivery mode of the learning intervention New question: What is the primary delivery mode?
Objective-level media selection	Select the media and instructional strategies for the objectives New question: How is interactivity accommodated?

3. Web-based with some face-to-face components (e.g., all of the course except the testing is conducted via the Web);
4. Web-based delivery;
5. blended (e.g., significant portions delivered face-to-face and significant portions delivered via the Web); and
6. other media (e.g., satellite, videoconferencing).

The six primary modes listed have many variations. Option 4, Web-based delivery, can be either synchronous or asynchronous. Synchronous delivery is place independent, but time dependent. For example, a Web broadcast seminar that is sent on a certain date and time is an example of synchronous delivery. Although the participants in the Web seminar do not have to be physically present at the same location, they must be present at the date and time of the scheduled delivery to participate. An Internet chat session is another example of synchronous delivery. Conversely, asynchronous delivery is both time and place independent. A Web-based management training course available at the convenience of the individual end user 24 hours a day, 7 days a week is an example of asynchronous delivery.

The choice of primary delivery mode should take into consideration all of the results from the analyses conducted during the analysis phase, especially the objective analysis, as well as the following additional considerations (Lee & Owens, 2000):

1. The number of learners that must go through the training,
2. The locations of the learners involved in the training,
3. The frequency at which the training should be delivered, and
4. The timing/urgency of the delivery for each learner.

Objective-Level Media Selection

Objective-level media selection identifies the media and instructional strategies to be used for each of the stated objectives. A host of new media options and associated instructional strategies is available on the Web. Web-based tools allow Web-based learning to escape the accusation that is often

leveled at distance learning interventions: They turn learning, which is a social process, into an individual process (Holmberg, 1995; Nipper, 1989). Today's Web tools allow the mediation of physical distance and permit social interactions regardless of physical proximity.

Moore (1993) suggests that instead of defining distance as the physical, or geographical, distance between the instructor and learner, distance should be defined as the level of interaction between the learner and instructor. Using this definition of distance, known as transactional distance, physical proximity loses its importance, and Web-based education is given the potential to create interactions equivalent to, or better than, those provided in the traditional classroom setting (Moore, 1993; Saba & Shearer, 1994). The learner interactions model, which is based on the idea of transactional distance, defines four interactions that must be included in all learning environments, including Web-based learning environments: learner-content interaction, learner-instructor interaction, learner-learner interaction, and learner-technology interaction (Hillman, Willis, & Gunawardena, 1994; Moore, 1989). Accommodating all of these interactions in the Web-based learning environment serves to mediate the physical distance between learners and instructor and between individual learners. Designers of Web-based learning should consider these four interactions when conducting objective-level media selection.

Learner-technology interaction. Web-based learning can accommodate the learner-technology interaction by providing Web tools training and ongoing technical support for learners participating in Web-based learning interventions. The tools training can be in the form of a Web-based orientation that learners must complete before starting the Web-based learning intervention, or it may be included in the first instructional unit in the intervention. By accommodating the learner-technology interaction, the designers are increasing the likelihood that the Web tools will facilitate learning, rather than become a barrier to it.

Learner-content interaction. The learner-content interaction is often thought of as the learner's interaction with the textbook used in the training, but it actually encompasses a wider set of resources and activities. There is a wealth of resources on the Web that can be incorporated into the learning intervention. These resources can be a valuable addition to any learning intervention, because they often are more up-to-date than the information found in textbooks. Web tools also allow for project- and case-based assignments that enable Web learners to engage in authentic, real-life activities. This project work can be shared among learners through assorted Web presentation tools, including learner-created Web sites.

Learner-learner interaction. The learner-learner interaction is often considered a challenge to accommodate in distance environments, but the availability of a host of synchronous and asynchronous Web tools makes the facilitation of

this interaction easily achieved. Learners can interact in real-time text, voice, or video chat activities where they meet together to discuss topics and share ideas. Alternatively, this discussion and sharing can occur asynchronously using e-mail, mailing lists, or discussion boards. Learners also can engage in group work through virtual team activities facilitated by these same synchronous and asynchronous tools.

Learner-instructor interaction. The learner-instructor interaction is a challenge in Web environments. Neither "the sage on the stage" nor "the guide on the side" adequately captures the role of the Web instructor. Generally speaking, the Web instructor is an online facilitator of the four learning interactions. The same synchronous and asynchronous Web tools that support the learner-learner interaction also support the learner-instructor interaction.

Design Tools and Skills

High-level and objective-level media selection yield information on the most appropriate delivery systems for a particular application. Because of the complexity of the selection process, Lee and Owens (2000) introduced a media analysis process (MAP) to help designers. MAP incorporates 26 elements to consider when determining delivery strategies. These elements are divided among learner, content, and cost considerations. Each element is associated with the most appropriate delivery technologies for that element. Compilations of all the potential elements and associated media determine the most appropriate delivery strategy.

Even with tools like MAP, design for Web-based learning interventions is complex and may require skills that individuals responsible for Web-based learning may not possess. These skills include knowledge of the instructional design process, as well as knowledge of Web tools and their instructional applications. Traditionally, training has been designed by instructional designers who worked closely with subject matter experts (SME). For the design of Web-based learning interventions, media specialists, information technologists, or instructional technologists may need to be added to the team.

Development

Before the proliferation of Web and other technologies, development primarily consisted of the creation of course materials and instructor guides. Development now includes the creation of one or more learning episodes on the Web. As shown in Table 6, the development phase includes detailed interface design (preproduction), the actual Web development (production), and review and usability testing of the product (postproduction).

TABLE 6: The Development Phase

Component	Purpose
Preproduction	Conduct the interface design New questions: What is the best interface design given the objectives? Should the development be outsourced? What skill sets are needed to conduct the development?
Production	Develop the Web-based learning intervention
Postproduction	Test and debug the product prior to implementation

Source: Adapted from Lee and Owens (2000).

Because Web-learning interventions are growing in popularity, there are interface standards that can direct Web development efforts. The ASTD has designed an E-Learning Courseware Certification (ECC) Program for asynchronous Web-based and multimedia courses (ASTD Certification Institute, 2002). The purpose of the certification is to recognize courses that excel in usability and instructional design. The certification standards are written at a level so designers and developers of Web-based learning interventions can use them to direct development and evaluate the finished product. A total of 19 standards are provided across four clusters. The four clusters are as follows:

1. Interface standards that address the relationship between the learner and the courseware;
2. Compatibility standards that address the relationship between the courseware, the operating system, and related applications;
3. Production quality standards that examine the quality of the courseware's text, graphics, grammar, and visual presentation; and
4. Instructional design standards that examine the relationship between the course purpose, objectives, instructional content, instructional methods, and the learner.

The ASTD certification standards also are useful for designers who decide to purchase the needed Web-based learning intervention, rather than build it. Although purchasing an ASTD certified course or program ensures a minimum level of quality, certification should be only one consideration in the purchase decision. A full vendor analysis should be conducted before making a purchase decision (Kruse & Keil, 1999). Many companies in the e-learning industry claim to have turnkey systems that will solve all problems. Purchasing such systems can cause huge problems if sufficient research is not done before making the decision. Vendor research should include an investigation of the venture capital of the vendor, their financial standing, and how long they have been in the industry. It should uncover the vendor's goals and objectives, particularly if the vendor is looking to establish him- or herself in the industry or if they are merely seeking to become large enough and important enough to be ripe for a buyout. A

vendor analysis also must include a thorough product analysis. It is important to determine the suitability of the purchased product for the learning need of the purchasing organization. A product that is "just right" for one organization can be completely wrong for another. The product analysis should include an investigation of the technical and maintenance support provided with the product, as well as a history of technical problems reported by customers.

In addition to the options of building a product in-house and purchasing a product from a vendor, organizations also have the option of contracting development services. With the contract option, an external development organization builds a product to a purchasing organization's specifications. These external development organizations have an arsenal of tools, termed automated development tools, at their disposal that allow them to quickly turn design specifications into Web-based learning products (Barron & Kane, 2001).

The build, purchase, and contract options address the needs of a range of organizations. For the many organizations without the in-house expertise needed to build quality Web-based learning interventions, a purchase or contract option may very well be their only way of getting the needed Web-based learning in the timeframe in which it is needed. The build option works best for those organizations with sufficient in-house skills to produce a quality product. These skills include, but are not limited to, project management, audio production, video production, Web authoring, editing, graphic design, instructional design, and application development (Lee & Owens, 2000).

To facilitate the sharing of Web-developed learning modules across vendors and across systems, the Department of Defense Advanced Distributed Learning Initiative is developing standards for the development of Web content. SCORM, Sharable Content Object Reference Model, provides design specifications for course structures, making course content portable between systems developed by different vendors (Oakes, 2002). These portable structures are known as reusable content objects. They allow content to be stored in a shared database and retrieved by multiple delivery systems. With optimal use of reusable content objects, a user can log on to a course, complete a diagnostic assessment to judge the user's prerequisite knowledge of the subject matter, and have an individually designed course automatically created for him or her as soon as the preassessment is completed.

Implementation

Because organizations have long been in the business of providing face-to-face training, most often the support structures needed for learner participation in the training already exist. The same cannot always be said for Web-based learning interventions; many times the support structures are not in

TABLE 7: The Implementation Phase

Component	Purpose
Implementation	Make the Web-based learning intervention available to learners New question: What learner and instructor support are needed for successful implementation?

place (Horton, 2000; Schrum & Benson, 2000b). As shown in Table 7, Web-based learning interventions demand that attention be directed to the learner and faculty support available during implementation.

Learner support includes such activities as technical support for problems with or questions about the technology; content support for problems with or questions about the content; social support for problems with or questions about the virtual interpersonal relationships; and administrative support for such functions as registration, testing, and certification.

An adequate technical support staff is imperative for all Web-based learning initiatives. This staff needs to be trained and available to assist both students and instructors with technology concerns. With 24-hour anytime, anywhere access to the course, a reasonable expectation is 24-hour anytime, anywhere access to technical support. To accommodate instances when learners cannot use the technology to access the technical support, a technical support telephone number (preferably an 800 number) should be provided to both learners and instructors. The availability of Web-based reference and troubleshooting guides are also of great help.

Learners also need structured and standard ways of obtaining assistance with the Web content. Although learners typically want 24-hour anytime, anywhere access to instructors, such access is not practical. Instructors have compromised and provided office hours in terms of real-time availability in a chat room or for telephone calls. Many online instructors set a maximum response time for e-mail to 24 hours, meaning that every student e-mail will receive a response within 24 hours.

Social support also is important for Web-based learning interventions. Learners must be provided guidelines for interacting in a Web-based course so that their expectations will be consistent with what they will experience. Because much Web-based coursework is conducted in virtual teams, an introduction to the functioning of virtual teams is almost always appropriate.

Instructors need technical support, just as the students do. In addition, they need ongoing maintenance support to help them with changes that may be required to the course content. Instructors also need training on teaching in a Web-based environment prior to their first Web teaching experience.

Evaluation

Formative and summative evaluations are conducted for Web-based learning interventions, just as they are for traditional classroom-based learning interventions. In formative evaluation, data about the intervention's effectiveness are collected while the intervention is in progress in order to make in-progress changes; in summative evaluation, data are collected after the intervention has been completed in order to make changes for the next implementation. The Web opens up a host of data collection opportunities to support both types of evaluation and, as shown in Table 8, raises new questions regarding evaluation measures and data collection strategies. For example, the Web allows for easy collection of time-on-task measures and instructional resource usage.

Evaluation of Web-based learning interventions can be discussed in terms of Kirkpatrick's (1994) four levels: Level 1, reaction; Level 2, learning; Level 3, behavior or transfer; and Level 4, impact or results. A discussion of Phillips's (1997) Level 5, return on investment (ROI), also is included.

Levels 1 and 2: reaction and learning. The use of Web-based evaluation strategies in a Web-based MBA program jointly developed by a Fortune 500 consulting organization and the business school of a major research university demonstrates the range of evaluation methods made possible by the Web (Schrum & Benson, 2000a). Formative evaluation data were collected from both students and faculty. Anonymously, students completed weekly Web surveys in which they answered questions related to the amount of time they spent on coursework, the learning activities they found the most and least effective, their experience with the Web tools that supported the course, and the level of interaction they had with their instructors and their fellow students. The surveys also contained open-ended questions that allowed students to comment on any other program aspects that they deemed important. This anonymous data were sent back to the faculty for review in weekly faculty meetings, along with assessment and observation data individual faculty members had collected in their respective classes. After a review of all the data, the faculty would decide what, if any, changes were needed to make the courses in the following week more effective. For example, in response to student concerns about the amount of time required to complete course assignments, program administrators decided to benchmark course assignments with an on-campus student to make sure that the time requirements were consistent with the stated requirements for the program. Rather than reducing the course load, based on the benchmarking data, the faculty chose to combine assignments across courses.

The weekly survey data from students were used for summative evaluation as well. The faculty and program administrators were able to look at trends across the term to better understand the student experience in the pro-

gram. For example, a recurring student complaint over the semester was the amount of work required in each of four classes they took during the semester. Based on this trend data, program administrators changed the program structure from four courses per 15-week semester to two courses per 8-week mini-term.

In this example, the Web easily allowed ongoing data collection for evaluation. The cost of data collection was minimal; the true costs were in the analysis time required by the faculty and program administrators. Although not all Web-based learning interventions require weekly data collection, such interventions must plan for the collection and analysis of effectiveness data. Minimally, four types of data should be collected:

1. Objective measures of student learning from course assessments;
2. Objective, usage measures that report how often students use individual course Web features;
3. Subjective, student data that report the student experience with the course, the academic and technical support, and the course Web tools; and
4. Subjective, instructor data that report the instructor experience with the course, the academic and technical support, and the course Web tools.

A special word about testing. Conducting assessments in Web environments can be challenging. In the traditional model, written tests taken in a classroom are used to judge the knowledge gained from a training event. Security and identity concerns make this type of assessment problematic in Web environments. Unless tests are monitored (which is easy to do in face-to-face environments), there can be no certainty who is taking the test and, therefore, whose knowledge is being evaluated. Two approaches have been used to address this situation. First, learners are required to take monitored tests at a physical test site, usually one that is convenient to their base location. Second, instead of using tests as a measure of competency or skill acquisition for reporting to a third party, tests are used only for learner self-assessment and feedback. Thus, rather than track test scores, Web course designs must incorporate tracking such items as time in a module or segment, time on an activity, time on test, time on a screen, frequency of access, number of help desk queries, error rates, and numbers and types of requests for additional information or coaching, and level of participation.

Levels 3 and 4: behavior and results. The Web also can be used to collect data from employers and supervisors on learner performance on the job after the completion of a Web-based learning intervention. A Web-based follow-up reporting system for supervisors can be implemented as easily as the ongoing student data collection surveys. Likewise, learners can complete follow-up assessments at their work location after they have had the opportunity to apply their skills on the job.

TABLE 8: The Evaluation Phase

Component	Purpose
Formative and summative	Describe how well the Web-based learning intervention met the stated objectives New questions: What are the appropriate Web evaluation measures? What are the appropriate Web data collection strategies?

Level 5: ROI. Determining the contribution of learning interventions to the organizational bottom line has always been a challenge; it remains a challenge with Web-based learning interventions. ROI is calculated by multiplying the total benefits of the Web-based learning by 100 and dividing that number by the total cost (Phillips, 1997). The formula is straightforward, but the calculation of total costs and total benefits is nontrivial. Some benefits are difficult to quantify, whereas others are considered not quantifiable at all. The key to successful ROI calculation is organizational agreement on what should be included in the calculation, and what the resulting calculated ROI value means. Each organization will have to make this determination.

Conclusion

This chapter has reviewed the ADDIE model of instructional design and has articulated new questions that the model must address in order to meet the challenges associated with the design of Web-based learning interventions. The Web brings opportunities and challenges for designers of learning interventions. The opportunities include the ability to provide anytime, anywhere accessibility to learning delivered "just in time." The challenge for designers is to effectively use the increasing array of Web tools to promote learning and enhance performance. Traditional instructional design models can help direct these efforts, but the models must incorporate considerations of the capabilities and limitations of the Web in their processes.

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