DISTANCE EDUCATION FOR TEACHER TRAINING:

Modes, Models, and Methods

Mary Burns
Education Development Center, Inc.
Washington, DC

EDC Education Development Center

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About the Author

Mary Burns is a senior technology and teacher professional development specialist at EDC. A former 10-year teacher in the United States, México, and Jamaica, she has worked in the area of technology-enabled professional development since 1997, instructing, designing, and evaluating both distance-based and face-to-face professional development for teachers, teacher educators, and instructional coaches. She has authored peer-reviewed papers, books, articles, and blog posts about teacher professional development, distance learning, and teaching with technology. She works in Asia, Africa, the Middle East, Latin America, the Caribbean, Europe, and the United States.

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Section II. Chapter 11

INSTRUCTIONAL DESIGN

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Best Practice: Distance education programs must pay careful attention to instructional design.

11.1 Overview

The good teaching, good instruction, and high-quality professional development discussed in the previous three chapters are contingent upon strong design of learning experiences or instructional design. Well-designed distance courses grounded in specific and measurable learning outcomes can increase teachers' knowledge in a particular domain, help them master content-specific pedagogical approaches, and develop practical skills such as questioning techniques (Moon et al., 2005). Poorly designed technology-based courses can confound learning, frustrate learners and instructors, and result in high attrition rates (Costley & Lange, 2017).

This chapter focuses on *instructional design* to support quality teaching and learning in distance education programs. *Instructional design* is a broad term that encompasses the selection, organization, sequencing, and assessment of content, as well as the materials and tools and the design and sequencing of experiences required to help learners attain a certain set of learning outcomes. Instructional design as a discipline emerged from the challenge of designing learning experiences with and through technology and is thus indispensable in a distance learning situation. This is particularly the case in asynchronous learning experiences, such as self-paced online courses or self-study print guides, where essentially all learning is connected to the quality of materials and the design and sequencing of activities.

The literature on best practices in instructional design is vast. This chapter presents in fuller detail the most salient themes regarding good instructional design for distance education courses. Some of the considerations noted here obviously pertain to some modes of distance education more than others. Where that is the case, they will be noted. For instance, Figure 11.1 provides examples of international standards for *online* course and program design.

While this chapter focuses on instructional design, the next chapter focuses on content and materials which obviously plays a central role in instructional design. Thus, these two chapters are companion chapters and should be read together.

11.2 Getting Started with Course Design: People, Approaches, Tools, and Processes

Teachers engage in instructional design all the time—in unit and lesson planning and in creating fun, engaging activities for learners. But technology adds layers of complexity to the instructional design process. Thus, the term "instructional design" often refers to designing learning experiences mediated through technology. But it is not a foreign concept to anyone who has designed non-technology based learning activities. As with in-person course design it is a multi-stage and integrated undertaking that focuses on the learner, learning, instruction, content, communication,

and assessment—but, in the case of distance education, all mediated through technology.

Figure 11.1
Standards and Frameworks for Online Course Design

Chapter 9 focuses on best practices and standards for professional development in general. Online learning is a particularly challenging form of education and professional learning because the learner's experience is almost entirely mediated through some form of technology.

The standards below focus on quality online course design. They are by no means the only online learning standards to which one can refer—many universities, for example, have their own standards. They are, however, internationally recognized and validated standards governing the design of online and blended learning experiences:

- The Association for Educational Communications and Technology Instructional Design Standards for Distance Learning are primarily geared toward universities but relevant for all distance education entities.
- The Australasian Council on Open, Distance and eLearning *(ACODE)* Threshold Standards for Online Learning Environments focus on developing course sites to ensure a level of consistency and quality in teaching environments.
- Quality Matters: Course Design Rubric Standards are intended for use with courses that are delivered fully online or have a significant online component.
- The National Standards for Quality Online Courses provide standards and guidelines for online courses.
- National Standards for Quality Online Programs outline standards and guidelines for online programs.
- The World Wide Web Consortium's (W3) standards are the technical specifications, protocols, and guidelines, including for accessibility, that drive the World Wide Web.

Each mode of distance education—interactive audio instruction (IAI) or print-based correspondence courses—will have learning products that are designed differently. Yet designing all forms of distance education courses share commonalities. They typically require multiple phases (audience research; planning; production; delivery; evaluation) and involve an instructional design team, an approach, a set of tools, and a design process. All of these components will vary based on the type of distance modality used and the size, scope, and budget of a distance education program, and they are discussed here.

11.2.1 Instructional Design Team

Distance education programs should be developed by experienced and qualified instructional design teams. This is a team with expertise in managing, designing, and producing distance education courses. It includes some variation of the following roles:

- **Project manager.** The project manager is the person who oversees all aspects of the course or program.
- **Subject matter expert (SME).** The SME is the content expert—in math, reading instruction, formative assessment—whatever the focus of the course may be. This person designs course content, activities, materials, and assessments, and focuses on sequencing, integration, and pacing to create a unified course. He/she may not be a technology expert or even know much about technology, thus will work closely with the instructional designer.
- **Instructional designer.** The instructional design expert collaborates with the SME and with the technical team. The definition of an instructional designer is somewhat variable. Often, he or she may be the person who takes the SME's ideas and content and creates eLearning or mobile-based activities using a particular software. In this scenario, the instructional designer functions as an eLearning specialist.

  Or the instructional designer may serve as an intermediary—"translating" between the

content requirements and technical aspects of a course, and often collaborating with the technical team to support them in creating a meaningful digital learning experience based on intended outcomes or activities.

Whatever role an instructional designer assumes, he or she should be highly fluent in teaching and learning, understand good design, and comprehend the affordances of particular technologies and how they promote certain types of learning.

- Technical team. This team can include any one or a combination of the following: a Web developer, graphic designer, video and audio production specialist, eLearning specialist, and/or a programmer.
- Other staff. For example, scenarios, animations, stories, audio, radio programs, or podcasts may require voice actors as narrators or to play the roles of teachers or learners. Visually based distance education and certain multimedia and online activities may need actors—people to play the role of an educator, student, or parent, particularly if design teams cannot get access to an actual classroom or when working in contexts where privacy protections are strict.

Specifically, in terms of *radio* and *television* programming, development teams will include curriculum experts, SMEs, audio and video production specialists, scriptwriters, materials developers, and voice and video actors (Richmond et al., 2021). For *print-based* learning, content development teams may include translators, script writers, general writers, a design specialist for layout and graphics, and a copy editor.

While the instructional design team outlined above is the preferred means of designing distance courses, the reality is that many distance programs are low-budget. Thus, the development team may only consist of the online instructor designing his or her own course *and* course content with some technical support.

11.2.2 Instructional Design Approaches

Typically, instructional designers use an approach or framework to guide the design of the entire program or individual courses. There are numerous instructional design approaches or paths for designing instruction, and each program will select the one approach or the combination of approaches that best fits its scope, budget, and philosophy. An instructional design (ID) approach is *not* a set of technical specifications; rather, as its name suggests, it guides or frames how technology-mediated instruction will occur. Instructional design frameworks can be used alone or in combination with another instructional design framework (for example ADDIE with Understanding by Design).

Figure 11.2 notes some well-known instructional design approaches, including two approaches—the 5Es and Understanding by Design (UbD)—that are focused on designing in-class lessons or learning units but that also have been successfully adapted for distance contexts. While the majority of ID approaches are specifically for online learning, they are germane to other forms of distance education and in some cases, in-person learning.

Whatever instructional design approach a distance education program chooses to use, it is important to ground this design framework in the experience of users (i.e., learners). User experience (UX) design is an umbrella term that exhorts instructional designers to focus on the needs and experiences of users—in particular, how users feel during the learning activity and their overall learning experience. UX designers then apply this knowledge to the development of a course or program in order to ensure that the user has the best possible experience (Interaction Design Foundation, n.d.). Piloting, which will be discussed at the end of this chapter, is an important ingredient in UX design.

11.2.3 Course Design Phases and Tools

Each mode of distance learning will require mode-specific technologies (audio recording

Figure 11.2
Instructional Design Approaches

Approach	Characteristics
ADDIE (Analyze, Design, Develop, Implement, Evaluate)	ADDIE was developed in the 1970s by Florida State University for the U.S. military (Molenda, 2015). It is intended to be a linear framework, although it is often used as a continuous cycle, and consists of the following five phases: • **A: Analysis.** At the analysis stage, the design team assesses the needs and goals of future learners. This allows for an educational experience that is relevant and personalized. • **D: Design.** This design phase is a planning phase. The instructional design team maps out the "big pieces" of the course itself—setting up the learning management system (LMS), wireframing the course, developing a syllabus, identifying actors, identifying the instructional approach of the course, outlining learning objectives, or all of these. • **D: Develop.** In this phase, subject matter experts and instructional designers develop educational materials and learning experiences—text, video, audio, recordings, presentations, and animations. They create scenarios, stories, assignments, project-based activities, discussion questions, and tests, and organize how teaching and learning are sequenced. This is the most extensive and time-consuming phase of ADDIE. Content is added to the LMS or burned onto DVDs, or print-based packets are produced. • **I: Implement.** The online course, mobile course, or audio program is launched with learners, ideally as a pilot or a beta test to identify problems, eliminate bugs, and correct mistakes. Often, however, distance learning experiences may be launched as full-blown courses or programs with no beta or pilot testing. • **E: Evaluate.** This phase involves both formative evaluation and summative evaluation. Although the original ADDIE framework terminates here, ADDIE is better considered a cycle, with data used to revise the course.
SAM (Successive Approximation Model)	Developed by Michael Allen of Allen Interactions, the Successive Approximation Model (SAM) is a simplified version of the ADDIE model, designed specifically to elicit feedback and build working models earlier in the instructional design process. It uses a recursive, versus a linear, process for course development and consists of three phases: 1. **Preparation phase.** This is a quick phase in which the design team gathers information about the intended audience. 2. **Iterative design phase.** This phase is characterized by the "Savvy Start"—the initial collaborative brainstorming meeting that establishes the foundation for a successful course. It focuses primarily on performance and serves as the starting point for team members to converse about course design. 3. **Iterative development phase.** Like the previous phase, in the Iterative Development Phase the design team rotates through development, implementation, and evaluation. As the course continues to be developed, design team members continually analyze and evaluate, so that at any point if a change needs to occur, it can happen quickly and limit budget or time risks (Allen Interactions, 2022).

Approach	Characteristics
Rapid Prototyping	Rapid Prototyping also builds on the ADDIE model, combining the design, development, and evaluation phases. It is a nonlinear approach, with three phases that are part of a continuous review and revision cycle: 1. **Prototype.** Course authors produce a **sample** working model that is a scaled-down representative version of the whole course. 2. **Review.** A particular instructional module is tested with learners to see how learners respond to content, instructional strategies, and activities, and to determine how well the technology serves as a conduit for each. 3. **Refine.** Learners provide feedback, designers make fixes, and learners test the prototype again. This process should continue until there is confirmation of the final product (Shift eLearning, n.d.).
5E Model[1] (Engage, Explore, Explain, Elaborate, Evaluate)	The 5E model is used for face-to-face, blended, and online learning, particularly for the design of HyperDocs. It was developed in 1987 by the Biological Sciences Curriculum Study and involves the following five phases (quoted from Bybee et. al, 2006): 1. **Engage.** The instructor or a curriculum task assesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize learners' thinking toward the learning outcomes of current activities. 2. **Explore.** The instructor or a curriculum task provides learners with a common base of activities within which current concepts (i.e., misconceptions), processes, and skills are identified. Learners may complete activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation. 3. **Explain.** This phase focuses learners' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. It provides opportunities for instructors to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the instructor or the curriculum may guide learners toward a deeper understanding, which is a critical part of this phase. 4. **Elaborate.** Instructors challenge and extend learners' conceptual understanding and skills. Through new experiences, learners develop deeper and broader understanding, more information, and adequate skills, and apply their understanding of the concept by conducting additional activities. 5. **Evaluate.** The evaluation phase encourages learners to assess their understanding and abilities and provides opportunities for instructors to evaluate learners' progress toward achieving the educational objectives (Bybee et al., 2006, p. 92).

[1] There is a second, unrelated 5E model that assesses learners' experiences and is discussed in *Chapter 19: Assuring Quality*.

Approach	Characteristics
Gagné's 9 Step Instructional Design Process	Developed in the 1960s, this is a long-established and highly regarded instructional design framework commonly used both in face-to-face and distance learning. The design process involves the following 9 self-explanatory steps: **1.** Gain the student's attention. **2.** Inform learners of objectives. **3.** Stimulate recall of prior knowledge. **4.** Present the content. **5.** Provide learning guidance. **6.** Elicit performance. **7.** Provide feedback. **8.** Assess performance. **9.** Enhance retention and transfer (Gagné & Briggs, 1974).
Understanding by Design (UbD)	Traditionally, instructional design has followed a *content*-focused rather than a *results*-focused design. Understanding by Design (UbD) was developed by Wiggins & McTighe (2005) as a framework for learning that focuses on attaining learning goals. Central to UbD is "backward design," a three-stage instructional design process that guides teachers in lesson or activity planning by beginning with the desired end result and designing "backwards" from this goal. Backward design is sequenced as follows: • **Identify the desired results or goals.** What should learners know or be able to do as a result of this learning experience? • **Determine acceptable evidence.** How will instructors know that learners have achieved desired results? What kind of formative and summative assessment should be built into the activity? • **Plan learning experiences and instruction.** What exactly will instructors need to teach? How should learners be grouped? How much time should activities take? What activities will best help learners meet learning goals? What materials and resources will learners need? How much should be lecture? How much should be self-discovery on the parts of learners? UbD is not a distance-based instructional design strategy *per se*, but rather a curriculum or course-planning framework that can be used in all distance modalities either as a stand-alone approach or as part of the instructional design frameworks mentioned above.

equipment) as well as general technology tools (computers, word processing software). Space limitations inhibit a detailed discussion of each technology tool required for designing in each distance education mode. This section instead discusses four sets of technology tools that correspond to the development phases for *online, blended,* and *mobile learning* experiences.

Constructing the course structure: Wireframing tools

In developing distance courses, design teams

often initiate the development process with wireframing. Wireframing is a way to establish the structure of the course and to lay out content, functionality, and navigation of the course before visual design and content are added. Designers may use wireframe tools, such as *UXPin*. Chart paper and sticky notes also can suffice.

Building course content, scope, and sequence: Storyboarding tools

Storyboarding is often the second step in online course design. While wireframes focus on structure, storyboarding focuses on content and on constructing a course narrative and is thus more information-rich than a wireframe. It involves visually mapping and sequencing the elements of a story, content topics, learning activities, or module. Storyboards can range in detail from rough stick figures, text and arrows showing actions, and sequence and flow to actual completed scripts, actions, notes, and finished visual elements. Whatever the product, storyboarding should include learning outcomes and ideas for assessing learning.

Distance programs can use dedicated storyboarding tools, such as *Moqups*, *Storyboarder, Storyboard That*; concept mapping tools like *Mural, MindMup, Visio,* or *Coggle*; simple tools such as Google *Docs* or *PowerPoint*; or the many free storyboarding templates that can be found online. And of course, distance programs can and do use pencil and paper for storyboarding.

Creating eLearning content and modules: eLearning authoring tools

eLearning authoring tools are software applications that design teams use to create multimedia-based eLearning content and modules. Such applications typically have a suite of tools that allow designers to create video, audio, animations, and assessments and they allow access to "digital assets," such as vector graphics,[2] digital images, or some video. Instructional designers can then combine this content into a structured learning sequence—a game, presentation, or interactive story that can be part of a *module*—a self-contained, multichannel unit of study. Modules can be mini-courses (mini-modules for microlearning), one component of a full course in a learning management system (LMS) or a learning experiences available via apps that can be accessed using tablets or phones, often offline. Some of the best-known eLearning authoring tools are commercial or "enterprise" tools—*Articulate 360, Lectora*, *Elucidat*, or *WeVideo*—and open-source *H5P*.

There are numerous reasons to use eLearning authoring tools. First, they tend to come with existing templates, which for novice instructional designers can make module design easier and faster and make the modules themselves more attractive and engaging than would otherwise be the case. Many *commercial* vendors have robust and highly responsive technical support and offer free continuing education in instructional design as part of the license fee. Many are full-suite, offering copyright-free digital assets, development tools, and, in some cases, their own version of an LMS where course designers can create and launch an asynchronous online course. Almost all eLearning authoring tools are SCORM and .xAPI compliant, allowing designers to easily export eLearning content into *Moodle* or *Canvas*, and many have strong accessibility features (to be discussed). Finally, designers can create their own modules and save them as templates or lesson frames for reuse for other courses. For commercial or enterprise eLearning applications, this all comes at what is often a high annual licensing cost. For open-source applications, which are often—but not always—free, this is often accompanied by steeper learning curves, a reliance on technical documentation, and the larger volunteer community for support.[3]

[2] Visit @virinaflora on Instagram for examples of vector drawings.

[3] There are service providers who support many open source tools for a fee. Most well-known are so called *Moodle* support providers such as *Moodlerooms*.

A particularly useful and free open-source tool that helps with wireframing, storyboarding, and developing eLearning content is *Twine. Twine* allows users to build stories, games, plans, and branching scenarios. Branching scenarios are what they sound like: A learner is presented with a scenario followed by a question or decision point that typically offers several responses or choices. The learner's choice creates several more options or branches that represent consequences of or additional questions based on those choices. Thus, branching scenarios unfold in non-linear and unpredictable ways. Branching is often used for multiple-choice quizzes, but in ways that dilute their potential richness. Where branching scenarios are particularly helpful is in showing learners the complexity of a situation; displaying multiple perspectives for an ill-structured problem or dilemma; or facilitating learners' careful consideration of the best-informed choice when there is not one right answer to a situation.

Course platform or distribution channel

Once course content is developed, it can be loaded into an LMS. LMSs, it should be noted, typically support HTML and XML and may—this is not a given—come with their own eLearning authoring tools, thus lessening the need for the eLearning authoring software mentioned above. Once content is developed and uploaded to the LMS, MOOC, or webinar platform, the course can be created and sequenced within the platform (i.e., organized by sessions, modules, or weeks) and directions and links to materials added, among other tasks. The platform makes it possible to register learners and launch the course and, in the case of most LMS and MOOC platforms, grade learners and generate reports.

11.2.4 Designing for Audio-Based and Visually Based Distance Education

The above course design phases are particular to online technologies, mobile technologies, and multimedia-based learning. Designing for IAI, radio lessons and broadcasts, and television will involve a different design process. Christina & Louge (2015) outline the design process for IAI, discussed in Chapter 2, as follows:

- **Preparation.** This phase introduces IAI to a context and provides initial engagement with stakeholders. It involves audience research, analysis of the educational context, assessment of technology options and production resources, and program design. The end product of this Phase 1 is a program design document.
- **Development.** Phase 2 involves scriptwriter training; scriptwriting; production of draft audio episode; and formative evaluation that prepares for the final production of user-ready episodes and supporting materials.
- **Production.** Phase 3 involves final production and post-production of audio episodes and preparation of supplementary learning materials for the program.
- **Delivery.** Phase 4 involves training teachers/caregivers in the use of IAI; mobilizing the host community; and delivering the program via radio, TV, MP3, mobile phone, or other technology (Christina & Louge, 2015, p. 5).

11.3 Distance Education Course Design Principles

Distance education for teachers is professional development. Like in-person professional development, it must be guided by the same standards and evidence-based best practices discussed in Chapter 9.

While technology is integral to distance learning, it cannot transform a poorly designed distance course into an excellent one. For that to occur, effective distance courses must be grounded in a series of design principles, discussed below.

11.3.1 Design for Quality Teaching and Learning

Many instructional design teams may spend more time on engagement versus learning and on the entertainment versus the instructional

characteristics of a course. While engagement is critical to learning, it is not the end state of a distance-learning experience—improved learning is. Thus, as it is in face-to-face learning, the North Star of distance education should be creating the most optimal teaching and learning experiences possible.

A high-quality distance learning experience must take into account multiple factors: the characteristics of targeted learners, the nature of the content, integration of ongoing feedback, and assessment. Designing such an environment requires the following:

- Development of specific measurable learning outcomes and clear learning expectations
- Connections between the learner's prior knowledge and course content
- Ample opportunities for practice and expert feedback to guide the development of knowledge in action (National Research Council, 2000)
- Learning activities that involve a variety of methods and approaches for both group and individual work and that are active and experiential to help learners construct meaning
- Learning experiences that are contextualized within a real situation and embedded in real communities of peers and experts
- Linking assessment to learning outcomes or performance standards *and* allowing learners to demonstrate their understanding through real-world applications; in particular, assessment should include self-assessment, and in synchronous courses, peer assessment
- Providing learners with opportunities for trial and error, reflection, and revision, and offering ongoing, timely feedback

11.3.2 Design for Adult Learning

Research demonstrates that adult learners share common characteristics and beliefs that must be integrated into any learning experience (McAleavy et al., 2018).

- They must be treated with respect and recognition and have their professional experiences integrated into workshops and discussions.
- They are practical and want solutions they can implement to address real-life challenges.
- They are self-directed and have to be given the opportunity to reflect on and analyze their own practice.
- They have to process information as part of learning.
- They have varied learning styles.
- They require the support of peers (Knowles, 1975).

Thus, distance courses must be centered on what teachers already know and the strategies, insights, and knowledge they need to measurably improve a problem of practice. Courses must focus on how teachers will enact the latest information and skills they learn, and which technologies—audio, video, multimedia—and formats—synchronous discussions, asynchronous reflections—can best help with both learning and classroom implementation of what they have learned.

11.3.3 Design for Learning Differences

Teachers, like the students they teach, may have undiagnosed learning disabilities (such as dyslexia), or they may have poorly honed reading and writing skills. They may prefer one kind of media (such as video) over another (text). The challenge for distance learning programs is to address teachers' learning strengths and compensate for their weaknesses. In addition to the course design principles mentioned above, distance courses can do the following:

- Use a variety of media. Some modes of distance education are better than others for distinct types of learning. For example, *print-based* instruction and *radio broadcasts* may help teachers understand the characteristics of differentiated instruction but may be far less effective in helping teachers understand how to implement differentiated instruction. *Visual media*, such as animations and simulations,

can help learners enhance their understanding of skills, such as differentiated instruction, or of processes, such as photosynthesis. They can demonstrate psychomotor or cognitive domainexpectations by showing the skill as a model against which learners can measure their performance. *Full-motion video* can be used to depict performance so that learners can emulate the processes, procedures, or behavior. *Images* can enhance vocabulary instruction and reading comprehension for poor readers. *Audio* narration can help poor readers comprehend information, and music can serve as a memory aid. (Again, Chapter 12 explores digital content and lists other specific tools for different content types, such as print, audio, video, and digital images.)

- **Use the multimedia principle to enhance learning.** Chapter 4 discussed multimedia learning—the concept that purposeful mixes of media are more effective for "sense making" and building "mental representations" of information than reliance on only one type of media (Mayer, 2009, p. 17). Thus, instructional design involves not just presenting information, but also presenting it in a way that encourages learners to engage in "appropriate cognitive processing" while also managing cognitive load (Mayer, 2009, p. 168).

Figure 11.3 outlines principles of multimedia design.

Figure 11.3
Mayer's Cognitive Principles on Multimedia (Mayer, 2009)

Cognitive principle	To improve leaning and reduce extraneous cognitive load, do the following:
1. Signaling principle	• Use cues that highlight the organization of the essential material.
2. Multimedia principle	• Use words and pictures rather than just words alone.
3. Segmenting principle	• Present multimedia in user-paced segments rather than as a continuous unit.
4. Pre-training principle	• Define key terms or concepts before diving into descriptions of processes.
5. Spatial contiguity principle	• Present corresponding words and pictures near rather than far from each other on the page or screen.
6. Temporal contiguity principle	• Present corresponding words and pictures simultaneously rather than successively.
7. Coherence principle	• Exclude extraneous words, pictures, and sounds.
8. Modality principle	• Include animation and narration (versus animation and on-screen text).
9. Personalization principle	• Use conversational, versus formal, language.
10. Redundancy principle	• Use animation and narration versus animation, narration, and on-screen text.
11. Voice principle	• Use a human voice to narrate versus a computer-generated one.
12. Image principle	• People do not necessarily learn better when the speaker's image is on the screen. Therefore, the instructor should use his/her face only when there are no words or pictures or to establish instructor or social presence.

In his final design principle, Mayer notes that these design effects may be stronger for low-knowledge learners than for high-knowledge ones (Mayer, 2009, pp. 271–272).

11.3.4 Design for Bichronous Learning

As discussed in *Chapter 5: Online Learning*, asynchronous and synchronous courses have benefits and drawbacks. From a materials design perspective, synchronous activities are easier to create although more challenging to teach and manage. But when designed to be interactive and collaborative, they can promote learning that feels less distanced—that allows learners to see each other, see their instructors, and feel part of a community.

On the other end of the continuum, asynchronous courses require error-free, highly engaging digital materials; thus, from a materials design perspective, they are more time-consuming and more expensive to design. Yet from an instructional perspective, asynchronous courses are easier to teach and manage. When designed well, with clear directions and learning outcomes, learners also can benefit from the sense of agency and being able to work at their own pace, time, and place of choosing.

Thus, distance education designers should maximize opportunities to get the best out of both modes of online learning and design for *bichronous* learning—that is, learning that employs synchronous and asynchronous activities (Dikkers, 2018). (Chapter 5 discusses bichronous learning in greater depth.) Synchronous activities such as experiments, debates, role-plays, and group solving can extend learner knowledge, provide opportunities for social-emotional interactions between peers and the instructor, and improve learner engagement. Asynchronous tasks, such as journaling, developing a portfolio, and discussions provide learners with opportunities to reflect more deeply and to hone important skills such as self-directedness and self-regulation. Asynchronous activities don't necessarily mean the learner always works alone. Instructors can structure learning opportunities that encourage collaboration-as-needed by accommodating flexible grouping options for completing work. Most critical is establishing norms for participation in a bichronous (asynchronous and synchronous) course to guide appropriate participation (Burns, 2020).

When thinking about asynchronous versus synchronous learning, course designers may want to consider the following questions:

- What's the best way to learn this body of knowledge or skills—alone or with others?
- When is it best for learners to work on their own time versus working in real time?
- How can we design asynchronous activities that are more collaborative?
- If we are bringing all learners together for a live class, how can we capitalize on this time together? What can learners do together that they cannot do alone?
- Can most learners join in a scheduled meeting? Does every learner have good connectivity and his/her own device?
- How can we design live Web-conferencing classes that are truly interactive?
- How can we best blend synchronous and asynchronous approaches within an overall unit of study? (Burns, 2020)

11.3.5 Design for Accessibility

The awareness of making all digital and distance learning opportunities accessible to all learners regardless of disability is increasingly at the forefront of instructional design. There are multiple options strategies for making online, blended, multimedia, and mobile learning courses accessible to all learners. Three are examined here—Universal Design for Learning guidelines; Universal Instructional Design (UID) principles; and the Web Consortium Accessibility Guidelines (WCAG). While they all share a common purpose (accessibility and inclusivity) and there is some overlap among the three, each is distinct.

Universal Design for Learning[4]

Universal Design for Learning (UDL) is an instructional design framework that guides the development of inclusive learning environments for technology-based and non-technology environments. It advocates that learning experiences (goals, methods, materials, and assessment) be purposefully designed to reduce barriers and create greater accessibility for all learners by providing multiple and flexible methods of representation, action and expression, and engagement (CAST, Inc., 2022).

UDL is an extension of the principles of universal design (UD) in architecture, products, and services first introduced by architect Ron Mace and colleagues. According to the Universal Design Institute now named for Mace, "UDL is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for specialized design" (Mace, 2019). One example of a barrier from the physical world would be stairs that are accessible to those who are ambulatory but not, in many cases, to the elderly, wheelchair users, those recovering from knee surgery, or maneuvering a baby stroller. A universal design to counter this barrier could be a ramp—which makes the building accessible to everyone.

A universal design example from the *virtual* world involves adding closed captions to a video. This helps individuals who are deaf or hard of hearing; it helps those whose first language is not the one spoken in the video; it makes it easier for people in loud or distracting environments such as schools or outside to access audio content.[5] These design choices offer the least restrictive—and alternatively strive to promote the most inclusive—environments. They place the barrier to learning not on the learner but on the curriculum—the goals, methods, materials, and assessments—that are the core of instructional design. This shift is the heart of UDL (CAST, Inc., 2022).

The UDL Guidelines developed by CAST are a tool used in the "implementation of Universal Design for Learning, to improve and optimize teaching and learning for all (learners)" (CAST, Inc., 2022). They revolve around three core principles that recognize the need to proactively design for learner variability:

- Provide multiple means of engagement to tap into learners' interests and backgrounds, their learning strengths, and to motivate them to learn. This may involve offering choices among various scenarios for learning the same competency to tap into diverse learners' interests, highlighting real-world relevance, providing a safe learning environment, challenging them appropriately, and motivating them to learn (Rose & Meyer, 2002; CAST Inc., 2022).
- Provide multiple and flexible methods of representation to give learners various ways of acquiring information and knowledge that reflect learner variability. This may involve flexible formats such as large print, voice-to-text applications, screen readers such as JAWS or NVDA, digital books or simply assuring that spoken information is also close captioned. This can also include modeling metacognition, providing outlines, semantic maps, and other such templates that help scaffold support.
- Provide multiple and flexible means of expression to provide learners with alternatives for demonstrating what they know and have learned. This may involve providing options for the use of different technology tools and incorporating different scaffolds, such as an online dictionary, job aids or chatbot support. This principle highlights the need to ensure that the means for expressing what one has learned align with that specific goal for learning; for

[4] Special thanks to Susan Bruckner, Education Development Center, for her guidance and feedback on UDL.

[5] UNICEF has long advocated UDL principles in basic teacher education, instructional design, and content development, particularly in Sub-Saharan Africa. See for example, UNICEF ESARO Guidance on Sign Language for Deaf Children's Education and Its Use in Accessible Digital Teaching & Learning Materials (2021).

example, the means to demonstrate learning are not in themselves the barrier.

Educators, including curriculum and assessment designers, teachers and distance instructors can improve educational outcomes for diverse learners by applying these principles to the development of goals, instructional methods, classroom materials, and assessments.

A significant body of research on learning and individual differences supports the three core principles of UDL: multiple means of engagement, multiple means of representation, and multiple means of expression and action. (See citations in Basham et al., 2018, pp. 484–485). UDL ultimately helps instructional designers make online, multimedia, blended, and mobile learning as accessible as possible—for learners with visual, auditory, cognitive, or motor impairment, in particular. But the ultimate goal of UDL is to ensure that learning is purposeful, motivated, goal directed, inclusive and accessible to all learners.

Universal Instructional Design

Teachers, like their students, have variability in preference, learning style, strengths, and challenges. Instructional designers are increasingly designing with this realization of both the online instructor and teacher-learner variability in mind, particularly in the case of Web-based learning, to provide a better experience for all users, including those with disabilities.

Based on UDL, and also expanding on universal design (UD) in architecture, products, and services, is Universal Instructional Design (UID)—the design of instructional materials and activities that make learning goals achievable by "individuals with wide differences in abilities to see, hear, speak, move, read, write, understand English, attend, organize, engage, and remember" (Burgstahler, 2007, p. 1, as cited in Elias, 2010). Figure 11.4 lists various principles of UID and demonstrates how designers can develop a Web-based distance education course that conforms to these principles.

World Wide Web Accessibility Guidelines

UDL is aimed at a broad range of learners, but learners with sensory, physical, and/or cognitive impairments may need greater accommodations. The Convention on the Rights of Persons with Disabilities (United Nations Department of Economic and Social Affairs, 2022); the Incheon Declaration (United Nations Educational, Scientific and Cultural Organization (UNESCO) et al., 2016); and the Sustainable Development Goal Target 4.5[6] all aim to ensure equal access to all levels of education for learners with disabilities (Burns, 2021). The United Nations has put in place robust design guidelines for distance courses for learners with special needs as well as those in emergency contexts (UNESCO, 2022). The European Union has explicit standards governing the design of distance and technology-based learning experiences (European Telecommunications Standards Institute, 2021). And in the United States, Title I of the Americans with Disabilities Act requires employers to provide reasonable accommodations to employees with disabilities, which could include providing assistive technology or other resources. Section 508 of the 1998 amendment to the Rehabilitation Act of 1973 requires all U.S. government digital content to be accessible (General Services Administration, 2022; United States Equal Employment Opportunity Commission, n.d.; United States Department of Health and Human Services, n.d.).

Those providing any type of Web-based distance learning should consult with the World Wide Web Content Accessibility Guidelines (WCAG) (World Wide Web Consortium, 2021). The guidelines are specifications or criteria *about* accessibility—they don't tell an instructional designer *how* to create accessible eLearning experiences. The designer must interpret the guidelines and apply them

[6] Sustainable Development Goal 4: Target 5 aims by 2030 to eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities.

Figure 11.4
Universal Instructional Design Principles: Example of Application for Web-Based Learning (Adapted from Mace, 2019; Elias, 2010)

Universal Instructional Design Principle	Examples of Materials and Design That Create Universal Accessibility
Equitable use. The design is useful and accessible for learners with diverse abilities and in diverse locations.	• All content online • Anytime, anyplace • Content available in local languages • Context is localized • Educational culture reflected in content and assignments
Flexible use. The learning design accommodates a wide range of abilities, preferences, schedules, and levels of connectivity. It provides learners with choice in methods of use.	• Multiple formats for information (print, audio, video, online, and CD-ROM/DVD/VCD-based) for learners with variable rates of connectivity • Mind maps, diagrams, and visual displays • Conferencing tools • Video and audio presentation and assignment tools • Slide presentation tools • Links to additional information • Choice of study of topics and assignments • Assignments addressing multiple learning styles
Simple and intuitive use. The course interface is easy to understand regardless of the user's background or knowledge.	• Simple interface • Direct link to new posts • Easy-to-navigate menus • Books • Searchable forums and content • Mobile interface • Access to offline resources
Perceptible information. The design communicates necessary information effectively to the user, even if the user has sensory impairments (e.g., vision problems, reading disabilities).	• Screen preferences, adequate font size, masking, and colors • Screen readers • Text-to-speech and speech-to-text capabilities • Captions for images and videos • Simple language • Chunk information (bullets, short paragraphs) • Sufficient white space on pages • Meaningful images with important text highlighted
Tolerance for error. The design minimizes adverse consequences of mistakes. Users can easily undo their mistakes.	• Easy for users to get back to where they were after making a mistake • Ability to edit after posting • Spell check • Confirmation before sending • Confirmation before deleting • Warnings when leaving course site

Universal Instructional Design Principle	Examples of Materials and Design That Create Universal Accessibility
Low physical and technical effort. The design can be easily and comfortably used with minimal physical and mental fatigue.	• Predictable and realistic amount of work • Sufficient bandwidth so user doesn't need to wait too long for audio, video, and multimedia content to load • Voice recognition • Word prediction • Built-in assistive technologies • Limited use of external links • Embedded multimedia and assistive technologies (e.g., screen readers) • Browser capability checker • Automatic redirection to resources
Community of learners and support. The learning environment promotes interaction and communication among learners and between instructor and learners.	• Uses community learning approach • Organizes offline activities (such as study groups, face-to-face meetings) • Links to support services • Provides ample opportunity for large-group and small-group discussions • Uses social media (e.g., *Skype, VoiceThread*, *Flip*), which allows users to see one another in real time • Provides online or face-to-face *coaching* for learners • Provides online or face-to-face *mentoring* for learners • Enables "verbal immediacy" from instructor—respond to learner's questions or concerns immediately • Supports regular communication (e-mail, SMS, chat, cell phones) from instructor to learners
Instructional climate. The instructor communicates high expectations. The instructor's comments are welcoming and inclusive.	• Instructor is involved in discussions • Instructor is available through several means (face-to-face, via Internet, via phone) for one-to-one discussions and assistance • Instructor is nonjudgmental • Learners are motivated by the instructor • Instructor offers noncritical useful feedback, helping learners address misunderstandings

to eLearning courses. The higher-level WCAG guidlines, minus supporting information, are noted below. A full copy of these accessibility guidelines can be obtained from the Bureau of Internet Accessibility (see the Reference section at the end of this chapter).

- Guideline 1.1: Provide alternative text for all content that is not text.
- Guideline 1.2: For live or pre-recorded multimedia provide synchronized alternatives such as captions.
- Guideline 1.3: Information and structure must be separable from the way the information is visually presented.
- Guideline 1.4: Make information in the foreground easily distinguishable from its background.
- Guideline 2.1: All functionality should be operable through a keyboard interface.
- Guideline 2.2: The user must have control of time limits on reading or interaction.

- Guideline 2.3: Users must be able to avoid content that may cause seizures or physical harm due to sensitivity to light and flashing content.
- Guideline 2.4: Users should have mechanisms to assist them in finding content, orienting themselves within it, and navigating throughout it.
- Guideline 2.5: Allow users to navigate and operate controls through various input devices, not just a keyboard.
- Guideline 3.1: Text content must be readable and understandable.
- Guideline 3.2: Placement and functionality of content needs to be predictable.
- Guideline 3.3: Help users avoid mistakes, but if errors are made, make clear how they can easily correct them.
- Guideline 4.1: Compatibility with current and future user agents (namely, assistive technologies) should be supported (Bureau of Internet Accessibility, 2021, pp. 1–9).

The WCAG sets three ascending levels of conformance: A, AA, and AAA. Level A success criteria include some of the most important accessibility checkpoints, but conformance to this level is insufficient since it leaves many critical accessibility barriers unaccounted for, rendering the website unusable and inaccessible for millions of learners. On the other hand, Level AAA success criteria include a number of aspirational accessibility checkpoints that, in the words of the World Wide Web Consortium (W3C), may "not be possible" to achieve. In an attempt to reconcile this tension, the W3C, through the Bureau of Internet Accessibility, recommends against defining Level AAA as a target level of conformance, stating that "it is not possible to satisfy all Level AAA Success Criteria for some content." Instead it strongly recommends that organizations maintain their websites, online courses, and apps to conform with all success criteria required for Levels A and AA (also known as A/AA) (Bureau of Internet Accessibility, 2021).

Assuring accessibility involves the use of appropriate hardware (e.g., assistive devices such as adapted trackballs), applications (e.g., screenreaders), content (discussed in the next chapter), the accessibility features of the tools that course designers use to create content (e.g., *Articulate 360* or MS *Office*), and course designer awareness. Space does not permit a full accounting of all the accessibility considerations of which course designers should be aware (e.g., the orientation of documents, proper heading orientations, or designing hover states for a cursor) and the course design team will hopefully include an expert who ensures accessibility compliance. A good place for the layperson to start, however, is to understand the impact of Alt-text, high contrast colors and typefaces/fonts.

Alternative text for images. Alternative text (alt text) is a concise description of a visual element, like an image or icon, that allows visually impaired users to understand the element and its context. Alt text also helps search engines understand and index the content of a page more easily. Many, if not most eLearning authoring tools, support this feature.

High contrast colors. Strong color contrast makes course elements easier to read and can make a course site attractive. It is a more critical importance, however. Many online learners, particularly males, will most likely have distinct types of color blindness and other visual impairments (National Eye Institute, 2019). High-contrast colors involves a combination of two or more contrasting hues, making it easier for users to find what they are looking for. They can be used for background and foreground elements, including text, icons, and images, to differentiate between the elements on the page.

Web sites such as *Color Safe*, *Contrast Grid*, and *Coolors*[7] allow course designers to see which combinations of high-contrast colors can be easily distinguished from one another by learners with color blindness; in the case of *Contrast Grid*, a table for each theme outlines which colors can be used together while maintaining a sufficient contrast ratio.

Typefaces and fonts. Typefaces and the font families[8] that comprise them influence the accessibility of a course site and the learner's ability to navigate that site. They also influence *legibility* (how distinguishable individual characters and words are to the eye of the reader) and *readability* (how easy it is to read the text overall) (Burns, 2019b, 2019c). Aging, the distance at which learners sit from a screen, font size, the degree of white space on a screen, lighting, screen resolution, and vision issues all affect readability and legibility (Carey, 2011; Tennant, 2011). Thus, using the same typeface and font family and assorted sizes of fonts (heading fonts and body fonts) cues the reader to the organization of text and navigation of the site—important markers for reading from a screen. Conventional wisdom within the eLearning design community has long exhorted that *sans-serif* typefaces (such as Calibri) typically enhance legibility and are best for reading off a screen while *serif* typefaces (e.g., Times New Roman) are best for reading printed documents (Burns, 2019c). However, as with many technology-associated topics, the research around such dichotomous recommendations remains inconclusive.

Font choices also influence a learners' responses to content, working memory, and learning (BBC News, 2010; Carey, 2011; Diemand-Yauman et al., 2010). Unfamiliar font types can create difficulty for learners. Some of this difficulty may be desirable—requiring greater attention and deeper cognitive processing because hard-to-read typefaces are more distinctive and involve greater attention to the task of reading. This, in turn, results in increased measurable outcomes in terms of learning (Diemand-Yauman et al., 2010). However, for learners with any kind of reading or visual impairment, unfamiliar font types may be undesirable—simply creating a higher level of unnecessary cognitive load that interferes with learning (Skulmowski & Xu, 2022).

Once developers finish designing their online course, they can use a number of free online sites, (for example, accessibilitychecker.org) to audit their course to ensure accessibility compliance.

Accessibility is a critical instructional design feature of any distance course; it is also a salient content development consideration and will thus be revisited in Chapter 12.

11.3.6 Design for Flexibility

One of the most common misconceptions in distance education is that face-to-face curricula can be transferred wholesale to a distance education environment (Herman & Banister, 2007). Although this unfortunately has often been the approach, distance education courses must instead be designed flexibly and specifically for the medium through which they will be delivered—be it radio, television, immersive environments, multimedia, or online courses (Hope, 2006).

"Flexible design," like the rubric under which it falls, instructional design, is a broad term that advocates providing learning resources and technologies to all learners in order to create, store, and distribute content (Hertz et al., 2020; Hope, 2006). It proposes that content be organized in multiple formats, used in a variety of activities, and be accessible through a variety of technologies to allow for customized learning

[7] Color Safe: http://colorsafe.co; Contrast Grid: https://contrast-grid.eightshapes.com/; and Coolors: https://coolors.co/

[8] A typeface is the set of design features for letters and other characters. A font family is a collection of fonts that share particular design features within a specific style of typeface. Read more about fonts in *Appendix 2: Glossary*.

experiences. Some of the key dimensions of flexible design include the following.

- Medium of delivery. The strengths of the technology delivery mode or model should be maximized, while its weaknesses should be mitigated.
- Organization. Content,[9] activities, and experiences should be sequential, cumulative, and coherent (South African Institute for Distance Education [SAIDE], 2005). They should be highly interactive and allow for a range of levels of learning, learner entry points, and experiences. Course designers should provide a "hook"—a question, dilemma, scenario, or problem—to immediately engage learners.
- Types of learner experiences. Flexibly designed courses favor ill-structured activities over well-structured ones, interactivity over passivity, inductive over deductive instruction, and activity over text and lecture. Such course design supports both individual and group learning and promotes applied approaches to learning.
- Digital tools. Digital tools must be functional, provide multichannel opportunities to build understanding of complex concepts, and allow for the completion of a range of tasks, including finding information, communicating, writing, reflecting, and organizing information) (Moon et al., 2005). Specifically, for an online course, LMSs such as *Canvas* or *Moodle* and digital libraries should be easy to navigate and understand. Fosnot's (1996) exhortation that technology should be not just a mode of delivery but a tool that supports constructivist learning opportunities—concrete, contextually meaningful experiences through which learners can search for patterns; raise their own questions; and construct their own models, concepts, and strategies—is as true today as it was decades ago.

In addition to being flexibly designed, distance courses should be flexibly delivered. "Flexible delivery" is a user-centered approach in which the providers commit to tailor courses to meet learners' individual needs (Hertz et al., 2020; Luschei et al., 2008). Flexibly delivered courses offer the following:

- Realistic options and choices in terms of time, place, and technology
- Multiple modes of delivery—in the workplace; at home; and in block modes, modules, interactive formats, and other nonstandard modes of delivery
- Alternative options—including on-campus and in-class; as independent lectures, seminars, tutorials, and practical sessions, as well as hybrid learning
- Accommodations for learners' diverse learning needs
- Use of technology and resources to provide options to any learners to access and use materials in their own place (e.g., Web-based teaching materials and exercises or assessments that are not platform specific or that are platform diverse) (Andrade & Alden-Rivers, 2019; Luschei et al., 2008).

As noted at the beginning of this chapter, inadequately designed distance courses have deleterious repercussions for the success of a distance education program. A poorly designed course may require excessive compensatory amounts of teaching and person power in terms of live presentations or ongoing coaching. It may have a high failure rate because learners are confused. It may result in the lowering of exit performance standards—or it may result in all of these. In contrast, well-designed courses lead to greater levels of participant learning and satisfaction (Costley & Lange, 2017).

[9] "Content" refers to text-based and multimedia content, including learning objects, all supporting materials (handouts), and technology elements such as video and audio, and it is discussed in detail in Chapter 12.

11.3.7 Design for Reduced Extraneous Cognitive Load

Chapter 1 briefly touched upon cognitive load, a concept that is highly relevant to technology-based learning, particularly online learning. Briefly, there are three types of cognitive load:

- **Intrinsic cognitive load.** This is about *content*—the complexity of the learning content in addition to the learner's prior knowledge of the content.
- **Germane cognitive load.** This is about *cognitive processing*—the cognitive resources that must be devoted to generating and storing newly acquired knowledge into long-term memory.
- **Extraneous cognitive load.** This is about *design*—the nature of how information is presented (Costley & Lange, 2017; Skulmowski & Xu, 2022; Sweller, 1988).[10]

Cognitive load theory argues that to achieve long-term learning, instructional designers must understand the limited capacity of working memory in conjunction with virtually unlimited long-term memory. Design choices around the organization, presentation, and sequencing of content, materials, and activities can induce extraneous cognitive load, thus interfering with the learner's ability to process information in working memory and encode that information into long-term memory (Skulmowski & Xu, 2022; Sweller, 1988). The task for instructional designers then is to reduce this extraneous cognitive load in order to leave sufficient cognitive resources to facilitate learning (Costley & Lange, 2017; Hultberg et al., 2018; Skulmowski & Xu, 2022).

Figure 11.5 (next page) suggests strategies for decreasing *extraneous* cognitive load to allow for greater long-term learning.

There are other design elements that can be used to reduce extraneous cognitive load—for example, elaboration and backward chaining (See Chapter 10, Figure 10.4). Figure 11.3, Mayer's Cognitive Principles on Multimedia offers strategies to reduce extraneous cognitive load. In short, instruction and the sequencing of instructional activities and materials must be designed in ways that *facilitate* learners' long-term memory and efficient retrieval of stored information at a future point in time versus impeding it (Costley & Lange, 2017; Hultberg et al., 2018; Roediger III & Butler, 2011; Skulmowski & Xu, 2022).

11.4 Time and Cost Considerations

All of these design considerations have time and cost implications. Because of the prevalence of data of online learning, vis-à-vis other distance modalities, this section primarily examines the time and cost considerations associated with *online* learning.

Two caveats frame the information in this section. First, because of the variability of online courses, estimating cost and time requirements for online learning are typically based on "one hour of online learning."

Second, the time and cost required to design an online course will obviously depend on the type of course (synchronous, asynchronous, bichronous); the content used; course length and requirements; the degree of interactivity; and the skill, size, and composition of the instructional design team and whether or not the instructional design team uses an instructional design framework. It will also depend on local salaries and benefits, the kind of software and platforms employed (enterprise versus open source), and whether the course has an instructor or not.

Given such variability, it is not surprising that there is no one definitive amount of time or a fixed cost for creating an online course. There are, however, well thought out estimates of time and cost that can guide distance education planning.

[10] This is a simplified version of cognitive load theory (CLT), and the theory has undergone updates since first developed; however, CLT largely hews to the framework described here.

Figure 11.5
Design Strategies to Reduce Extraneous Cognitive Load

Design Strategy	Explanation
Ensure course design consistency	• Make sure that content and learning activities are consistently organized in a predictable pattern (Herman & Banister, 2007). • Design routines. The same types of content should be posted in the same places each week (e.g., weekly checklist first, then readings, then a link to the discussion board, followed by small assignments). This consistency also reduces learner anxiety (Herman & Banister, 2007). • Use consistent fonts, colors, logos, visual organizers, and navigation, which enhances learner automaticity of navigation and access of materials. • Create modules or sessions that are more or less the same length.
Focus on design clarity	• Pay attention to ease of access and navigation, as well as to design features such as the use of sufficient white space, graphic organizers, bulleted and "chunked" text, and visuals and color to aid in comprehension and retention of information (Mayer, 2009). • Ensure that materials are clear and intuitively organized. This significantly reduces extraneous cognitive load and influences learners' satisfaction and perceived learning of course material (Costley & Lange, 2017; Mayer, 2009; Swan, 2006).
Minimize reading from a screen in favor of other digital tools	• Chapter 1, Figure 1.2 discusses the challenges of reading from a screen: Print and text are often less effective means of explaining concepts and processes (Taflinger, 2011). • Graphic organizers, images, immersive activities, and video all can provide rich conceptual, procedural information without taxing the learner's cognitive load, as is the case with reading from a screen (Taflinger, 2011). • Provide print packets of course readings and text-based materials to reduce reading from screens.
Organize content from basic to complex	• Information should move sequentially from simple to complex, concrete to abstract, and general to specific (Hultberg et al., 2018; Moon et al., 2005). • Match the complexity of the material to the level of expertise of the learners (use assessments) and present material sequentially. • Organize information from basic to increasingly complex concepts so learners are able to retain more information in their working memory (Moon et al., 2005).
Build in opportunities for retrieval practice	• **Retrieval practice** involves "situations in which knowledge is expressed, including situations where learners must produce the answer to a factual question, explain a concept, make an inference, apply knowledge to a new problem, and produce creative and innovative ideas" (Karpicke & Grimaldi, 2012, as cited in Hultberg et al., 2018, p. 33). • There is much evidence for the benefit of retrieval practice (Brame & Biel, 2015, as cited in Hultberg et al., 2018; Roediger III & Butler, 2011). • To build in opportunities for retrieval practice, consider the following: ◦ Test learners' prior knowledge, particularly when the test is more challenging for memory (See *Chapter 17: Assessing Distance Learners)*

Design Strategy	Explanation
Build in opportunities for retrieval practice *(continued)*	◦ Design low- or no-stakes quizzes (formative assessment) ◦ Develop self-tests ◦ Have learners demonstrate understanding by solving hands-on or authentic problems that require the use of the key underlying concepts and principles (Hultberg et al., 2018, p. 34)
Use distributive practice	• **Distributive practice**, or spacing, involves distributing retrieval practice over time, thus encouraging learners to schedule shorter study sessions over a longer period of time and avoid "cramming." • It is based on "Forget to Learn Theory" (Carey, 2014, as cited in Hultberg et al., 2018, p. 34)—learning is strengthened when a learner has time to partially forget the material before recalling it to complete a task or answer a question. • The main purpose of spacing is to disrupt memory loss in order to improve long-term retention. (Research shows that shorter study time increments over a longer period of time is more effective than cramming [Hultberg, et al., 2018, p. 34]) • To build in opportunities for distributive practice or spacing, consider the following: ◦ Carefully structure courses, explicitly communicate the distributive practice to learners, and provide a syllabus that makes this structure and expectations clear and transparent ◦ Design assessment strategies that space out assignments during the course of study in a way that stimulates learners to practice their knowledge and skills over time, helps diagnose and monitor achievement of learning outcomes, and provides multiple opportunities to give constructive feedback to learners ◦ Include short reviews at the beginning of each class as a recap of previous material (Hultberg et al., 2018, p. 35)
Interleaving	• **Interleaving** is the practice of mixing related but distinct material during learning sessions, obliging students to discriminate between problems and select appropriate solution methods given the context. • Learning improves if learners study and switch between multiple concepts or problems during a single course session, and the general rule is to switch to a second concept before they have mastered the first concept (Lang, 2016, as cited in Hultberg et al., 2018, p. 37). • To build in opportunities for interleaving, consider the following: ◦ Pose questions that elicit explanations, such as those with the following question stems: why, what caused X, how did X occur? What if, what-if-not, how does X compare to Y, why is X important? Use these types of questions especially when learners struggle expressing explanations on their own. ◦ Focus on deep questions and model answers to these questions in order for learners to build a more complex understanding of a topic and to build deeper explanations of key concepts. Deep explanations mean explanations that focus on causal mechanisms, planning, well-reasoned arguments, and logic. ◦ Alternate practice of diverse types of content. When teaching, ask learners to alternate between distinct types of problems or ideas, rather than covering ideas sequentially. ◦ When giving multi-step problems, encourage learners to identify and label the substeps required for solving the problem (Hultberg et al., 2018, p. 38).

11.4.1 Time Requirements

Perhaps the best known estimate of time needed to design an online course is (still) that of the Chapman Alliance (2010). As Figure 11.6 outlines, they sort eLearning into three levels—from least to most interactive (Figure 2.3 in Chapter 2 defines "interactivity"). In turn, they crosswalk each of these three levels with their rigor and intended outcomes, categorizing them as "simple," "average," or "complex."

- Simple courses involve basic content, such as readings, passive experiences, and limited deliverables from learners. They are often repurposed in-person activities.
- Average courses include many "try it yourself" exercises and deliverables from learners.
- Complex courses require extended time by learners, more advanced interactions, more customization, and more complex learner deliverables).

A more focused and recent lens through which to examine eLearning development time comes from Defelice (2021) who, based on surveys of 264 online course developers, documents the time needed to develop one eLearning course *module.* She defines a "module" as a block, session, or unit of study for each instructional product (personal communication, January 12, 2023). These development times are shown in Figure 11.7 and are organized by level of engagement or interactivity. As an example, a 20 minute "passive" module, essentially focused on information consumption, requires an average of 48 hours to create.

Figure 11.6
Time Needed to Design "Leveled" Online Courses (by Hours) (Chapman Alliance, 2010)

Levels of eLearning	Simple	Average	Complex
Level 1 (Basic): Level 1 typically involves *PowerPoint* presentations, readings, graphics, perhaps simple audio, perhaps simple video, and test questions. These are basically pages with assessment.	49	79	125
Level 2 eLearning (Interactive): Level 2 includes the above eLearning content plus 25% (or more) interactive exercises, allowing learners to perform virtual exercises, and liberal use of multimedia (audio, video, and animations).	127	184	267
Level 3 eLearning (Advanced): Level 3 is highly interactive, possibly simulation or serious game-based, uses avatars, has custom interactions, and is an award-winning caliber courseware.	217	490	716

Figure 11.7
Average Time (in Hours) Required to Develop eLearning Modules by Degree of Learner Engagement (Defelice, 2021)

Modules: Levels of engagement	Average module length (minutes)	Average time to develop (hours)
Passive (readings, watching videos)	20	48
Partial engagement (drag and drop, roll overs, simple animations, and gamified elements)	26	84
Moderate engagement (some games, activities, animations)	20	116
Full engagement (many immersive games, scenarios, simulations)	17	155

The above information sheds some light on the final product of the instructional design process. But there are differences in time estimates—Tucker (2019), for example, suggests that one hour of eLearning requires approximately 184 hours.

A bigger question than the total number of hours of development time centers on the design process itself. On what tasks do eLearning developers primarily devote this development time? What course development tasks require more versus less time? Figure 11.8 breaks down Tucker's estimate of 184 hours visually displaying the various activities that one hour of eLearning development comprises.[11]

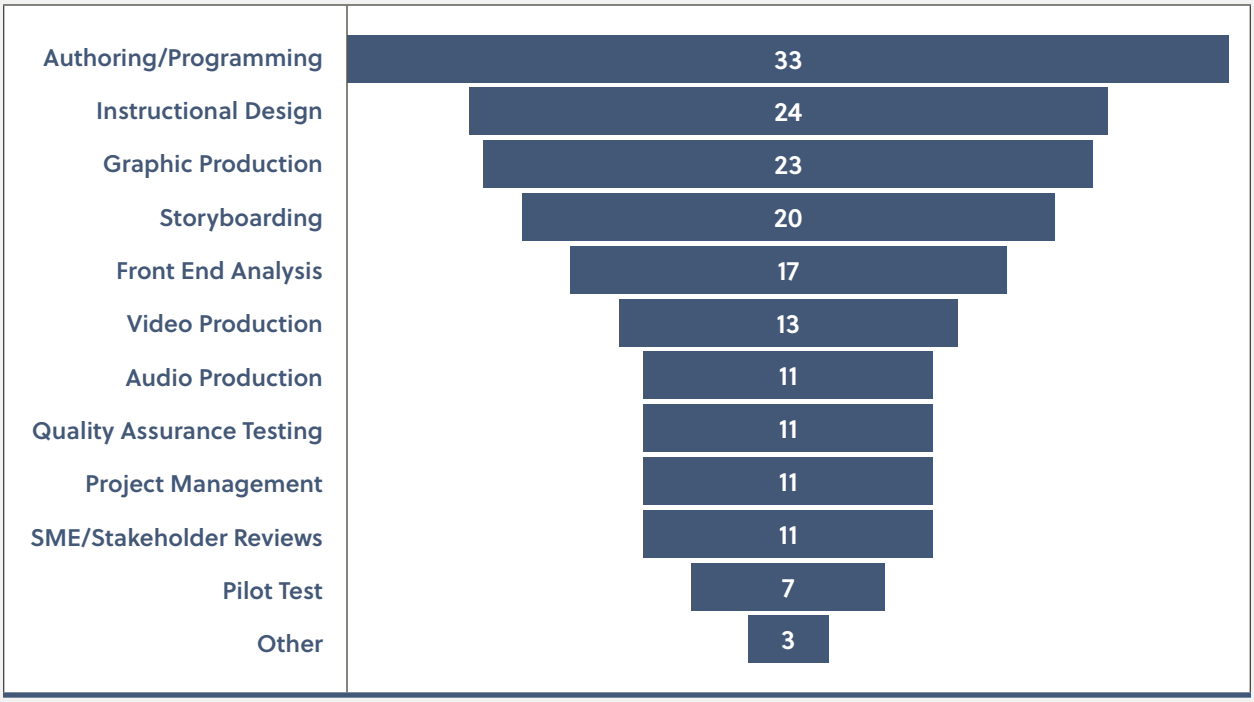
While time estimates vary, the above figures can at least guide distance education programs as they assemble an instructional design team, develop scopes of work, and plan a deliverable timeline.

11.4.2 Cost Requirements

It is challenging to calculate the exact amount of time needed for distance course development—and it is equally difficult to determine a precise cost. As will be echoed in *Chapter 12: Developing Content*, costs depend on a variety of factors—the type of course, its length, degree of interactivity and rigor.

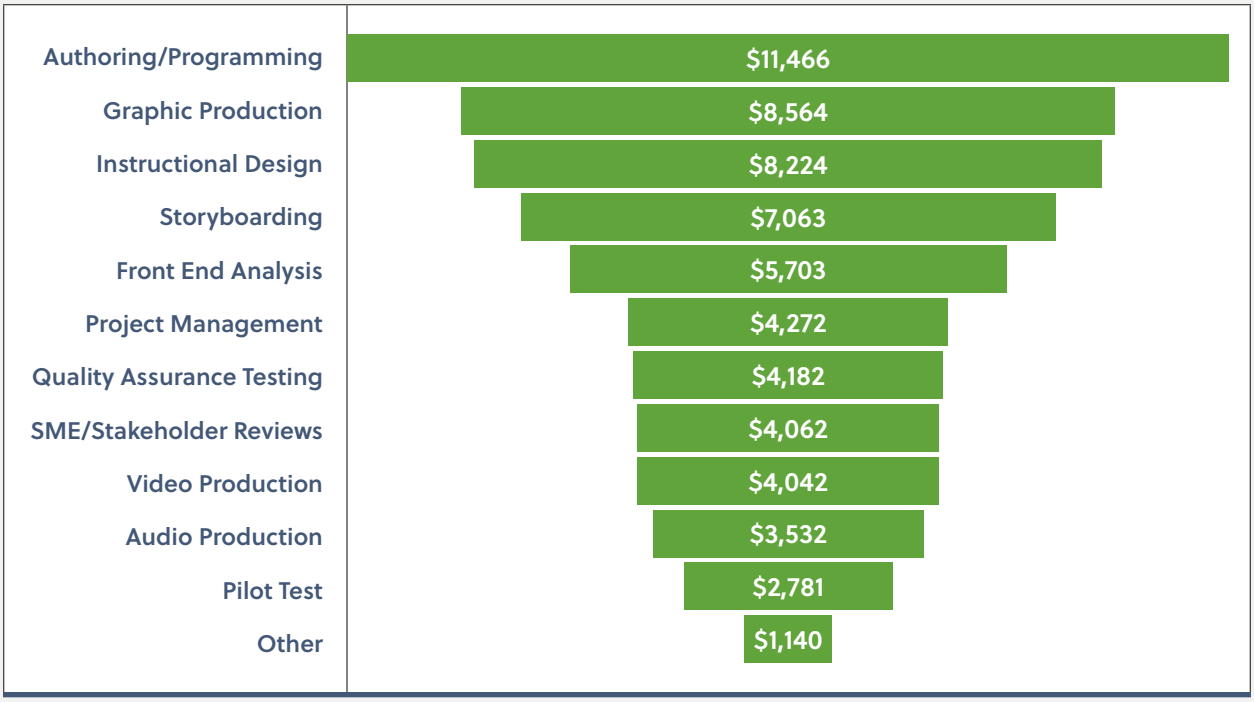
To assess the cost of designing an online course, we turn again to the Chapman Alliance's detailed cost information. For the Level 1, 2, and 3 courses discussed in Figure 11.6 and which differ by levels of interactivity, the Chapman Alliance (2010) estimates development costs of $12,980 for simple courses, $23,991 for average courses and $65,031 for complex courses. Overall, it estimates that on average one hour of eLearning costs $65,030 to produce (All of these amounts have been recalculated into 2022 dollars).

Figure 11.8
Breakdown of Tucker's Estimation of Hours Required to Develop One Hour of eLearning (Calculations based on Tucker, 2019)



[11] While Tucker disaggregated these tasks by *percentage*, this chart calculates those percentages into *actual hours*.

Figure 11.9
Cost Per Online Course Development Activity Required to Develop One Hour of eLearning (Calculations based on Chapman Alliance, 2010; U.S. Department of Labor, n.d.)



Chapman Alliance data also attach specific costs to the eLearning development activities visually displayed in Figure 11.8 per one hour of online learning. This cost breakdown is based on their $65,030 estimate and is illustrated in Figure 11.9 (above). All cost data are converted into 2022 USD.

Unfortunately, there are a number of weaknesses with these precise cost estimates. For example, in Figures 11.8 and 11.9 audio and video materials are costed out but other forms of content, such as print or text, which often constitute the bulk of online learning courses, and multimedia, are not. These cost estimates also fail to identify whether the course is synchronous, asynchronous, or both, and whether the cost of course delivery includes the cost of an instructor (for courses that have one). Research from U.S. online schools reports that they can spend between $2,334 and $3,821 on instruction per full-time equivalent (FTE) learner (Hoxby, 2017, p.424).

We also can examine the cost of distance courses via modality as Figure 11.10 does. Using original 1998 cost data from South Korea's National Open University (KNOU) converted to 2022 USD, Figure 11.10 estimates total costs and costs per learner of three distance-based modalities—TV, radio, and online learning—with more detail about content and instruction.

As Figure 11.10 (next page) suggests, TV, radio, and online courses all come with significant production costs. However, online learning reaches fewer learners and has higher costs per learner completion versus TV or radio-based distance courses. While this allows us to determine costs *prima facie*, it does not allow us to determine the worth or value of the educational experience offered by these three modes.

Thus, as seen in this section, developing distance courses—particularly online ones, and particularly those that are interactive and rigorous and that involve the use of rich media such as video and multimedia—require considerable time and resources. The greatest barrier by far to distance course development is limited resources—time,

Figure 11.10
Costs of Distance Education at KNOU Converted to USD (2022)
(Jung, 2000, p. 229; U.S. Department of Labor, n.d.)

Modality	TV-Based Course	Radio-Based Course	Web-Based Course
Type	16 weeks, 3 credit	16 weeks, 3 credit	16 weeks, 3 credit
Media	Textbook, TV programs, and face-to-face instruction	Textbook, radio programs, and face-to-face instruction	Textbook, video and audio clips, and online instruction
Number of learners	1000	1000	30
Cost to produce and deliver (USD)	$137,659	$60,226	$22,370
Cost per learner (USD, rounded)	$138	$60	$746
Attrition rate (%)	60%	60%	10%
Cost per completed learner (USD)	$344	$151	$829

budget, skilled personnel, and tools (Defelice, 2021). Those wishing to design quality online courses need to ensure that they have sufficient amounts of all four of these resources.

11.5 Piloting Distance Courses[12]

Finally, at the culmination of the instructional design process, distance education providers should make every effort to pilot their courses. A pilot is a user test or a dry run of the online course before it is fully launched. It is an opportunity to test out the course in "petri dish" conditions with a smaller cohort of users to gather information on the technology, directions, content, activities, and whole user experience, so that any problems can be fixed before the course is fully launched (Burns, 2019a).

There are numerous reasons to pilot an online course, the most important of which is that piloting has a *formative* function—allowing course designers to "dip stick" the effectiveness, usability, and functionality of the course from a broad user perspective, thus informing designers about what works and what doesn't so that problems can be fixed. Pilots also serve as an early warning system about the technology, particularly regarding whether it facilitates or impedes the desired teaching and learning of the course. And pilots serve as an early warning system about the *educational* aspects of the course—distance education providers may discover that content, activities, and assessments are simply too complex or simplistic, irrelevant, or inappropriate for their intended audience, or that directions are so unclear that the learner doesn't know what to do (Burns, 2019a).

[12] This section is adapted from Burns (2019a) "Yes, You Should Pilot Your Online Course: A Few Things To Consider As You Do," eLearning Industry, https://elearningindustry.com/pilot-your-online-course-things-consider. Adapted with permission from eLearning Industry.

Pilots have numerous purposes and numerous beneficiaries. In addition to course designers, they also can help *funders and decision-makers* understand what additional resources may be necessary to ensure that online courses are a success. They can help orient, prepare, and introduce *online learners* (especially novice ones) to the rigors, demands, and responsibilities of an online course, especially those courses of medium and long duration. They also help *online instructors* self-assess, and be assessed, on their own performance so they can adjust facilitation strategies, response time, presentation of content, and directions. They can allow *education officials at national, regional, and district educational offices to* understand what sorts of offline supports are necessary to help teachers transfer learning from the online course to their actual classrooms (Burns, 2019a). Finally, they are an important first step in an overall process of quality assurance.

A pilot should have two main traits. First, it should be done *before* the full launch of an online program, not after, although it doesn't have to be 100% complete. Second, it should be *formative* in nature, not evaluative. A pilot's aim is to identify what works for the user and what doesn't, so designers can undertake evidence-based corrective actions, inputs, supports, and design considerations to ensure a successful teaching and learning experience for the online instructor and learners (Burns, 2019a).

11.6 Conclusion

One of the major benefits of distance education is that it can provide opportunities to a broad expanse of learners and to nontraditional or traditionally underserved learners. But to truly support those who learn in nontraditional ways, and to address the variability of every learner, distance education must continue to move beyond a one-size-fits-all approach and offer multimodal learning opportunities that are differentiated according to learner needs.

Figure 11.11
Instructional Design Resources

- **Online course design is both science and art.** Check out an example of an eLearning module (created in Articulate *Storyline*) as well as U.S.-based instructional designer Jodi Sansone's eLearning design portfolio.
- **Instructional design information and resources.** Two comprehensive sites are InstructionalDesign.org and Instructional Design Central.
- **Learn how to do instructional design.** Follow the MIT and New Media Consortium's "Online Course Design Guide's" comprehensive step-by-step framework on designing distance courses.
- **eLearning authoring tools.** See eLearning Industry's review of all eLearning authoring tools.
- **Instructional design checklists.** Cathy-Moore.com offers a number of good online tools, rubrics, and websites to help designers evaluate their instructional design process. Access her checklist for strong design. Check out, too, the Articulate.com eLearning course review checklist. Finally, the Course Design Rubric Standards (6th edition) can guide institutions of higher education in designing quality courses (Quality Matters, 2019).

As the "father of instructional design," Robert Gagné, noted, not all instruction is equal (Gagné & Briggs, 1974). Therefore, distance courses must integrate an array of experiences, assignments, activities, and assessments that allow learners to interact and practice with content in multiple ways; on multiple cognitive levels (comprehending information, applying it, analyzing its effects, and evaluating its impact); and using multiple measures and methods to assess this learning. This is the essence of instructional design.

The ultimate goal of instructional design is to "promote better understanding of concepts so that effective learning can occur" (Costley & Lange, 2017, p. 186). To do this, and to create the diverse experiences mentioned above that all learners require and that address the variability

of human learning, instructional design must be grounded in an understanding of learning—specifically adult learning. It must link theory to practice and ensure that overall design is flexible, attractive, engaging, and free from extraneous cognitive load. It must capitalize on and customize various technologies, such as multimedia, to reach the greatest number of learners possible and ensure their academic success. Finally, it must ensure that distance education materials and experiences are accessible to all learners regardless of their physical abilities or learning differences.

We turn now to one of the most critical elements in instructional design—high-quality content and materials.

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